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Pathways to a Sustainable Future: A Curriculum Guide for Schools Exploring Waste Management Issues. 1999

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PATHWAYS TO A SUSTAINABLE FUTURE

A Curriculum Guide for Schools Exploring WASTE MANAGEMENT Issues

DEVELOPED BY
The Chewonki Foundation
for the Maine Waste Management Agency

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Pathways to a Sustainable Future was developed by the Chewonki Foundation under contract to the State of Maine, Maine Waste Management Agency, and published in 1994 for use in Maine schools.

Shortly after cooperating with Chewonki in this venture, the Maine Waste Management Agency was disbanded, and its functions divided among other State and non-profit agencies under some coordination by the Waste Managment and Recycling Program, Maine State Planning Office. In 1996 Chewonki undertook the preperation of a revised edition of Pathways for additional and wider distribution.

The Chewonki Foundation is a non-profit educational institution established in 1963 as an outgrowth of Camp Chewonki, which was founded in 1915. Chewonki began year-round programming in 1970 and currently offers Camp Chewonki (for boys 8-15) and Wilderness Expeditions (for boys and girls 13-18), Environmental Education and Outreach Programs for school groups, the Maine Coast Semester (for 11th graders), and Workshops and Wilderness Expeditions (for family groups and individuals). The Resource Center at Chewonki works closely with a number of state and federal agencies, school districts, and individual schools to develop new programs and educational materials. All projects and associated teacher training programs stress aspects of group process and interdisciplinary learning. *All Chewonki Foundation programs are drawn clearly and cleanly from its educational mission: To foster personal growth through group interaction in the context of the natural world.*

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Table of Contents

Introduction: Planning Your Trip **8**

The Birds of Zazurds **12**

A Story About Waste and Action

Awareness Pathways **35**

Assessment Pathways **75**

Action Pathways **102**

Background Information **147**

Appendices **179**

I. Tools for Action
II. Instructional Resources
III. Organizations & Agencies
IV. Glossary

Alphabetical Index **198**

Introduction: Planning Your Trip

Only through responsible and effective social action will we reach our destination: A Sustainable Future.

Although defining "responsible" and "effective" in this context is an important task, Chewonki does not know exactly how to define them in your situation, and so we will leave that finally to you, remaining in our accustomed role as guide.

What *we do know* is that responsible and effective social action requires *empowerment*. Today's students are generally more aware of the environment and the problems of "trash" than their teachers were in their own school days. At the same time, however, kids tend to feel smaller and less powerful in the face of the world around them. We must be careful not to mistake their growing awareness for a dependable commitment to a sustainable future! *As children take action, they feel less helpless about their ability to make a difference and more hopeful about the future.*

We also know that responsible and effective social action is founded upon solid information about the subject and about the process. You've got to know where you are and what you're talking about before you can persuade others to follow your lead. That's why Chewonki's guides to environmental action focus on the relationship among ***awareness pathways, assessment pathways, and action pathways.***

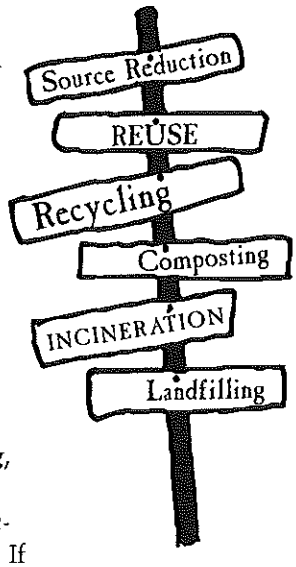
Please do... take some time to leaf through this book a section at a time: **The Birds of Zazurds** is an engaging story that reaches students at all levels with "the big picture." The 12 ***awareness pathways*** help students answer the question "What is the waste problem?" and help them understand their role in the problem and in some of the possible solutions. The 8 ***assessment pathways*** help students answer the question "How are we (am I) doing?" The 19 ***action pathways*** challenge students to make an impact on the waste problem. **Background Information** and **Appendices** provide general support, and the **Alphabetical Index**–inside the back cover–helps you move quickly around the book.

Please do... observe the symbols which indicate the levels within the K-12 range for which each ***pathway*** is intended. Note the wide range within each level and substantial overlap between levels.

● Beginning	K–4
■ Intermediate	3–8
◆ Advanced	6–12

Please do... start where you wish. Each ***pathway*** can be seen as complete in itself, and contains references to obvious helps and relationships to other ***pathways***. Consider, however, the **Birds of Zazurds**, and selecting, or creating yourself, a follow-up activity to challenge your particular students. Many of the early ***awareness pathways*** are excellent starting points, full of props and pizzaz. At some levels consider starting at **Simple Classroom Action Projects**, or with one of the ***assessment pathways.***

Please don't... fail to guide students to ***assessment*** and ***action pathways***. There is no "summit" along these ***Pathways to a Sustainable Future***, but there are heights of land which you are urged to attain. The views from these heights are wider, more complicated and realistic, and often more striking.



Please do... read **Background Information: Overview** at the outset. For one thing, you will want to set in mind the **Waste Management Hierarchy**, by which it is understood that *Source Reduction (Reduce!)* is preferred to *Reuse*, which is preferred to *Recycling*, and so on through *Composting*, *Incineration*, and *Landfilling*. If you're planning an extended trip for you and your students, you may want to post the hierarchy in a prominent place.

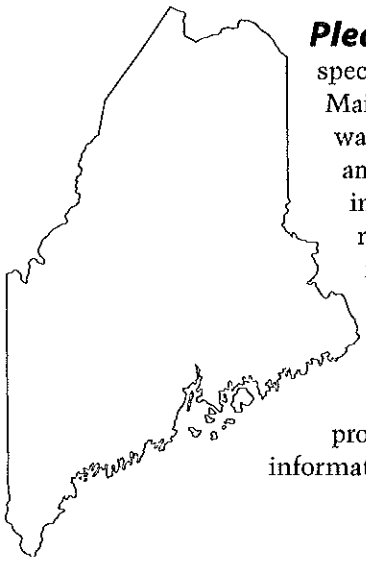
Please do... Reach out for assistance to *all parts of the community* as you negotiate these (sometimes technical or controversial) **pathways**. If you are a bit bewildered by the prospect of teaching about aluminum recycling, waste-to-energy incinerators, or even composting, there are people quite nearby who know these subjects well, and, with the help of a professional teacher, will enjoy communicating that knowledge to students. *As the century turns we take it as given that educational activities must aim to be collaborative.* And that means–especially–don't forget *families*. . .

Please don't... overlook the potential of environmental subjects to engage *families.* Because managing trash–like breathing the air, paying the water bill, watching your family's health, viewing the landscape—is something parents do every day, you'll find them open to teaching and learning about it.

Please do... adapt *Pathways* to the learning objectives and goals that you have set for your classroom, your school, or your school district. **If Toys Could Talk**, outlined here as a one or two day ***awareness pathway***, could with a bit of imagination become a month-long unit on local history for fourth graders. The teacher looking for a new way to teach percentages might apply his creative touch to **School Waste Audit** (an ***assessment pathway***), where each new day there are differing amounts of differing trash found in various parts of the school. You might adhere closely to our outline of the ***action pathway*** **Promoting Alternatives to Hazardous Products**, or you might see it as the platform for a semester course in language arts and communication! Or in chemistry!

Please do... employ *Pathways* in pursuit of State Learning Results or National Standards. These sets of expectations commonly have the effect of encouraging cross disciplinary teaching, and recognizing "process skills" in communication, self-understanding, group work, task management, leadership, etc. Environmental subjects, especially if they extend into action, contain the same resistance to boundaries and emphasis upon process skills.

Please do... be creative in assessing student attainment for each ***pathway***. The general objectives we have posed for each of the ***awareness*** and ***assessment pathways*** may be helpful, but we did not wish to limit the adaptability of a ***pathway*** by further defining its outcomes in print.



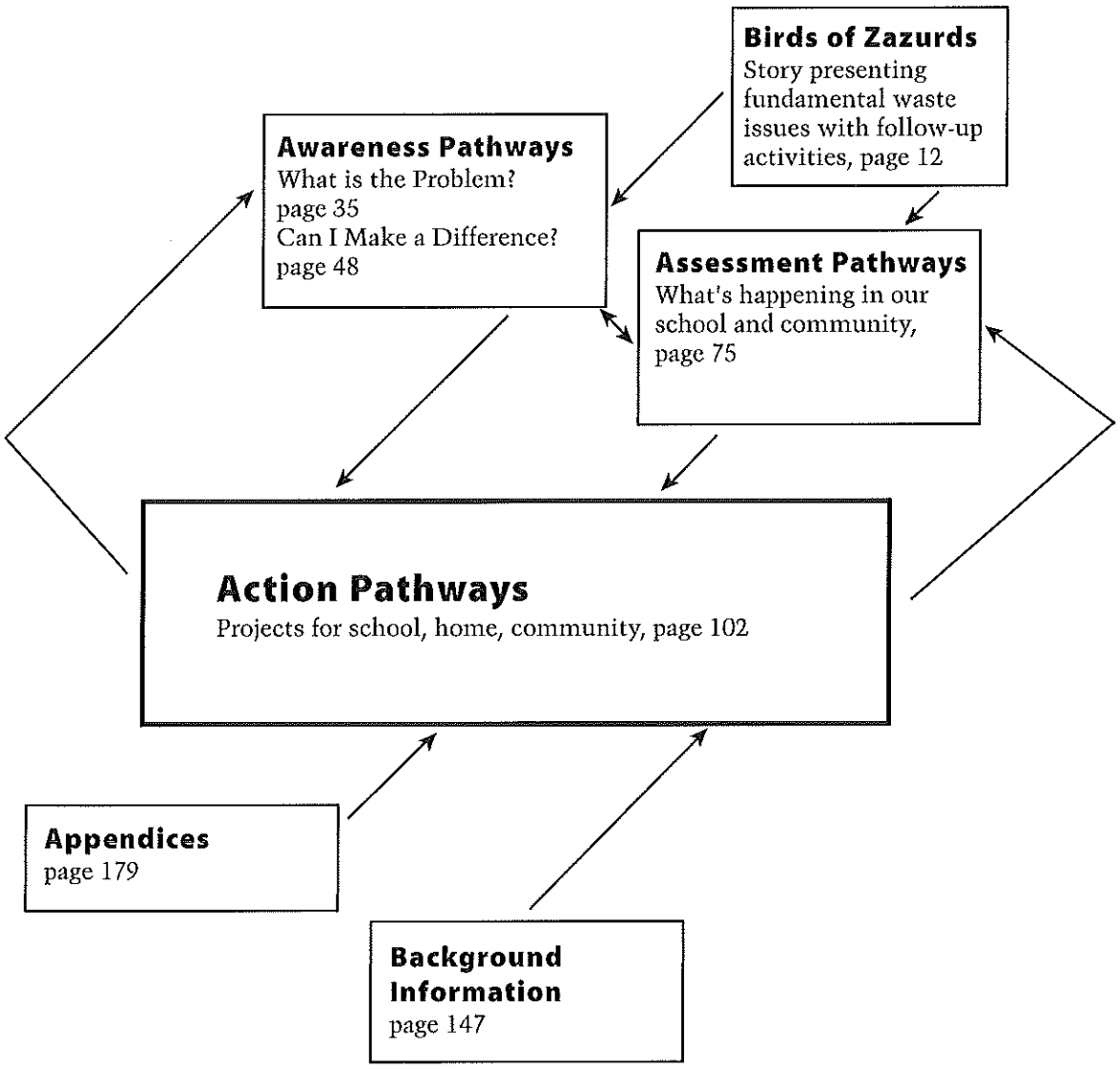
Please do... enjoy our occasional special reference to the great State of Maine! The 1994 edition of Pathways was produced by Chewonki and the State of Maine to be used in Maine schools, and we have retained many of the Maine references. Your State's waste management officials (visit www.epa.gov/grlakes/seahome/housewaste/src/states.htm) will be able to provide you with equivalent information.

Please do... Organize *Pathways* at the classroom, school or school system level. With the broader implementation strategies, students will participate at several different stages, teachers will talk to each other across grade levels and cross-age activities will develop. Working across age groups does wonders for the motivation of all. Consider entrusting the organization of ***Pathways*** to a group consisting of, for instance, the middle school principal, the local recycling coordinator, a high school science or social studies or language arts teacher, an elementary school teacher, a parent, and perhaps one other "expert" from the community.

Please do... Visit **www.chewonki.org** to let us know you are using ***Pathways***, to find updated information, new pathways, assessment ideas, feedback from other schoolpeople, and to contribute *your ideas*. We plan no further printed revisions of ***Pathways*** waste management materials, but with your help will make page revisions and additions available at this site.

Flow Chart

Pathways to a Sustainable Future


Birds of Zazurds
Story presenting fundamental waste issues with follow-up activities, page 12
Awareness Pathways
What is the Problem? page 35
Can I Make a Difference? page 48
Assessment Pathways
What's happening in our school and community, page 75
Action Pathways
Projects for school, home, community, page 102
Appendices
page 179
Background Information
page 147

The Birds of Zazurds

A Story About Waste and Action

Level
- ● Beginning
- ■ Intermediate
- ◆ Advanced

by Andy Barker
illustrated by Josephine Ewing
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"The Birds of Zazurds" may seem too advanced for some Kindergarten and First Grade classes.* The Lorax *by Dr. Seuss is an alternative introductory story to introduce the issues of caring for the environment and looking at our behavior.

Advanced level students may be motivated by anticipating a presentation to younger students.

The Birds of Zazurds introduces students to some of the basic waste issues of our time. Written in the spirit of Dr. Seuss, the story takes the Zazurds Backwards Flutter Birds from their idyllic origins in the Gulligut tree, to their environmental crisis, the big crack. Students suggest solutions as the new generation of Birds comes to grips with their problem. Follow-up activities help the students relate the Birds' experience to their own school and community. The Birds of Zazurds Play gives intermediate students the chance to share the story with younger classes.

This story can raise many additional environmental issues for students. The discussion questions do not address the obvious population problems created by the Birds. Teachers are encouraged to explore topics of interest with students even if they are peripheral to the topic of solid waste.

Overview

The story is a good beginning for most classes to look at waste issues in general and see what problems they have around them. Reading the story will motivate students to ask "What about us?" The discussions and activities will get them to start thinking "What can we do?"

Discussion Questions 30

Follow-up Activities

Our School the Gulligut Tree ● 31
Overview: This is a project where students make drawings to compare the Gulligut tree and their school. The drawings show how the Birds of Zazurds and people dispose of their waste.

The Birds of Zazurds Play ■ 32
Overview: Students dramatize the Birds of Zazurds and put on a play for younger classes.

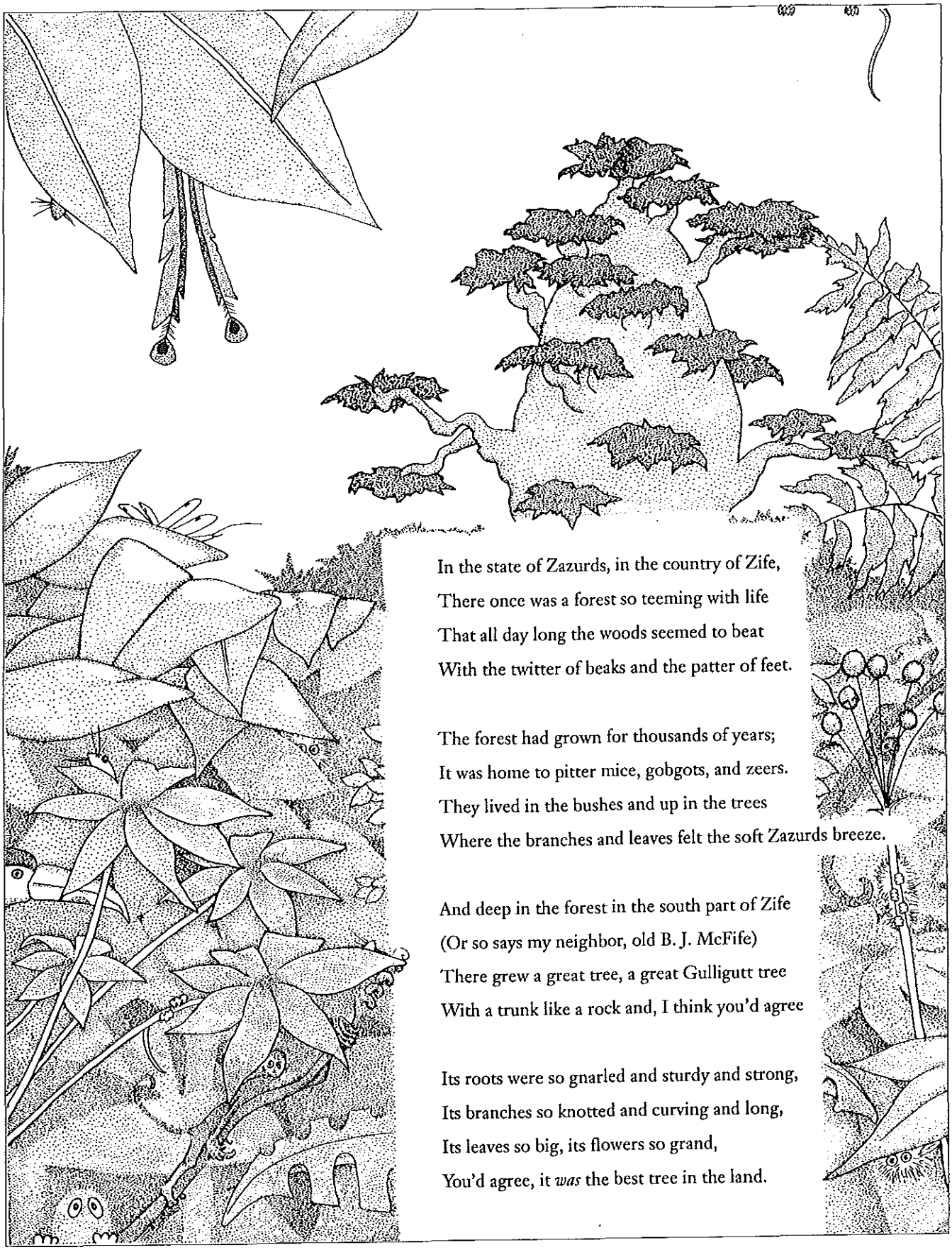
Zazurds II ◆ 33
Overview: Students write and illustrate a sequel to the story "Birds of Zazurds."

Time Planning

The story takes about 30 minutes to read, including the two breaks for discussion. This may vary according to the age group. Some teachers of young students prefer to break in the middle of the story, then complete the reading and discussion later.

The final discussion takes about 10 minutes.

Plan a separate period(s) for the follow-up activities.



In the state of Zazurds, in the country of Zife,
There once was a forest so teeming with life
That all day long the woods seemed to beat
With the twitter of beaks and the patter of feet.

The forest had grown for thousands of years;
It was home to pitter mice, gobgots, and zeers.
They lived in the bushes and up in the trees
Where the branches and leaves felt the soft Zazurds breeze.

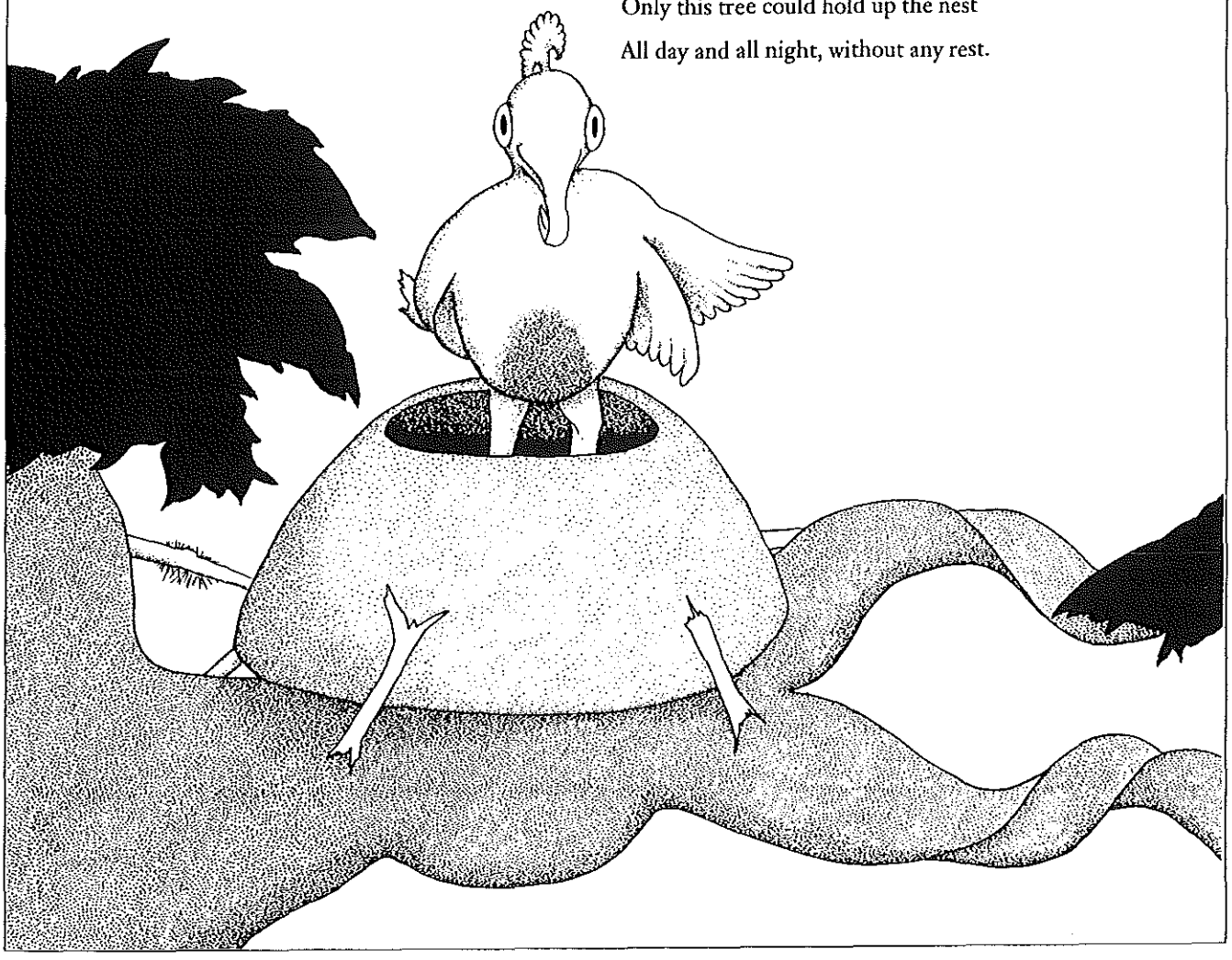
And deep in the forest in the south part of Zife
(Or so says my neighbor, old B. J. McFife)
There grew a great tree, a great Gulligutt tree
With a trunk like a rock and, I think you'd agree

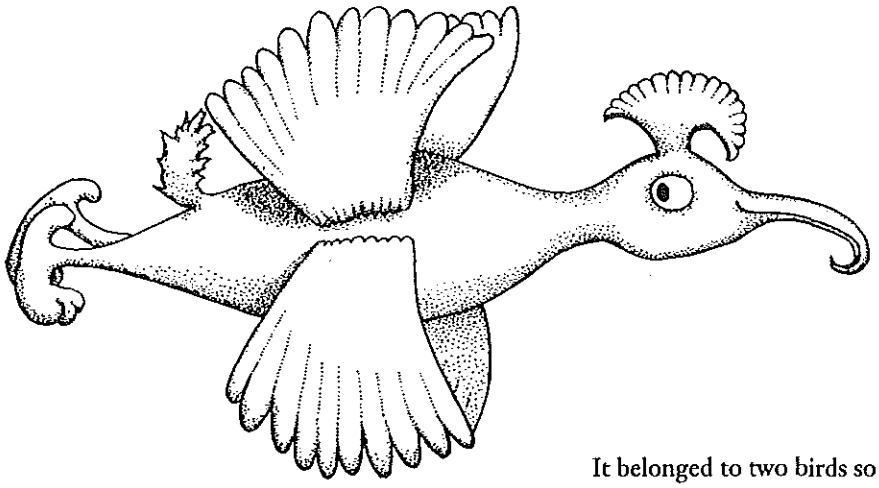
Its roots were so gnarled and sturdy and strong,
Its branches so knotted and curving and long,
Its leaves so big, its flowers so grand,
You'd agree, it *was* the best tree in the land.

And way up high in the tip-tippy-top
Of that Gulligutt tree, something was propped.
It was a nest! Like no other nest
One hundred miles east or one hundred miles west!

The nest was quite simple, made of twigs and dry mud;
It kept out the rain in the heaviest flood;
It was soft on the inside and tough on the out;
The top was quite skinny, the bottom quite stout.

And the nest was so big, so heavy and bold,
That only this tree, or so I've been told,
Only this tree could hold up the nest
All day and all night, without any rest.

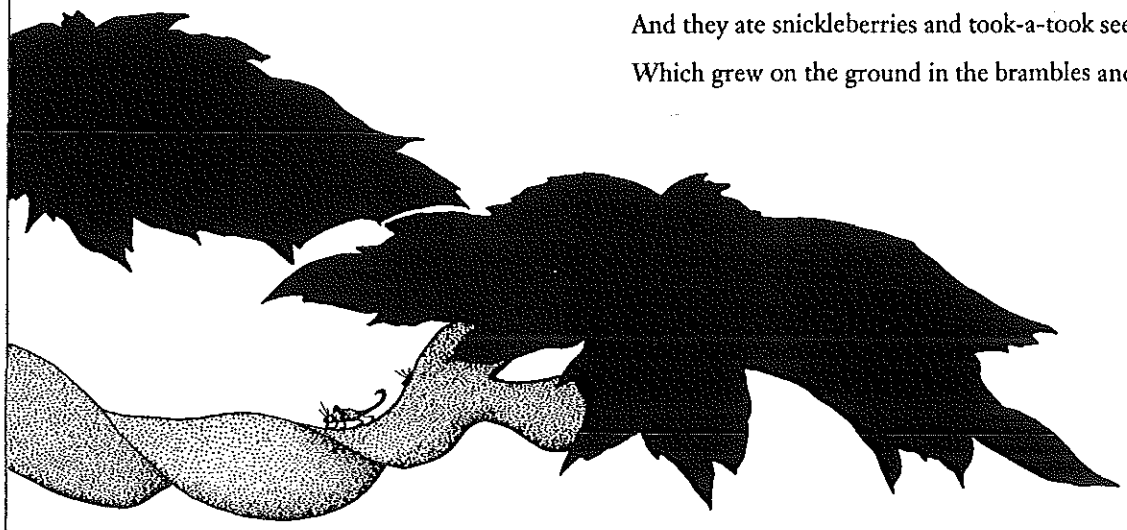


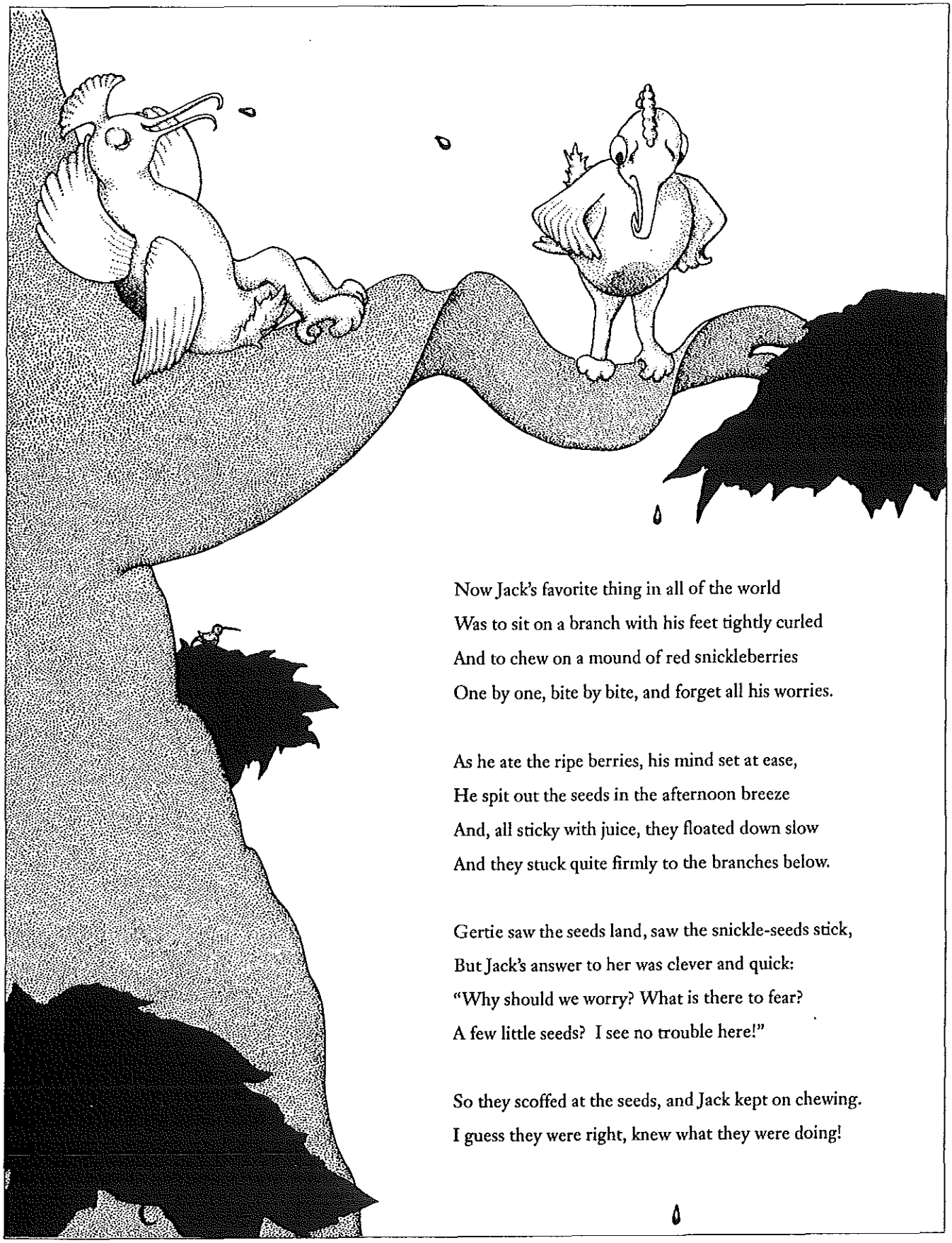


It belonged to two birds so rare in that land
You could count on the fingers of only one hand
And still count them all, in the whole land of Zife,
In the whole living world (or so says McFife).
And though it sounds odd, though it's downright absurd,
They were called the Zazurds Backwards Flutter Birds!

They flew on four wings with their tails going first,
Their heads going last, and their feet in reverse.
And that might be a hint why just two of these birds
Lived in that Gulligutt tree in Zazurds.

One's name was Gertrude and one's name was Jack
She had red on her belly, he had red on his back.
And they ate snickleberries and took-a-took seeds
Which grew on the ground in the brambles and weeds.





Now Jack's favorite thing in all of the world
Was to sit on a branch with his feet tightly curled
And to chew on a mound of red snickleberries
One by one, bite by bite, and forget all his worries.

As he ate the ripe berries, his mind set at ease,
He spit out the seeds in the afternoon breeze
And, all sticky with juice, they floated down slow
And they stuck quite firmly to the branches below.

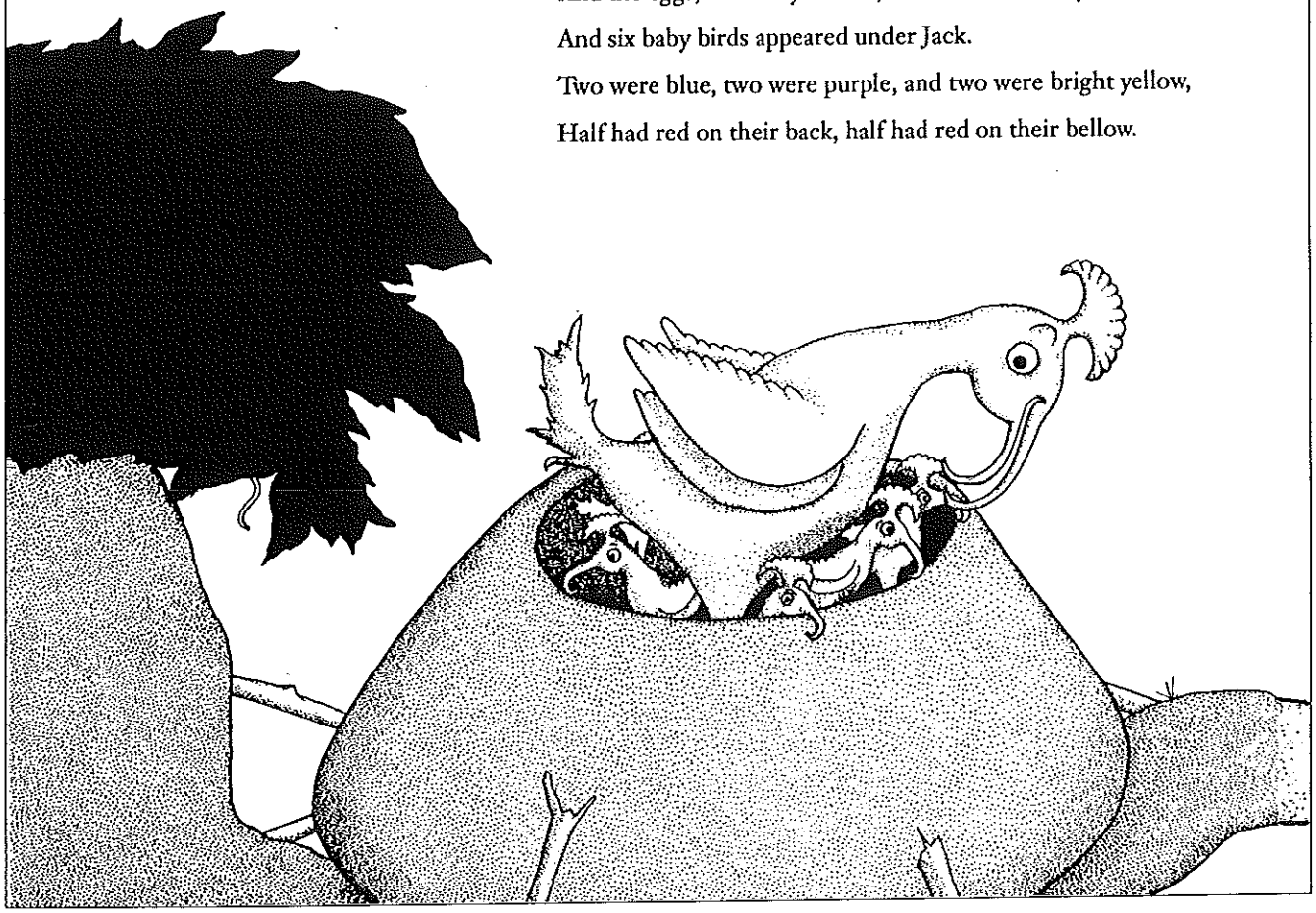
Gertie saw the seeds land, saw the snickle-seeds stick,
But Jack's answer to her was clever and quick:
"Why should we worry? What is there to fear?
A few little seeds? I see no trouble here!"

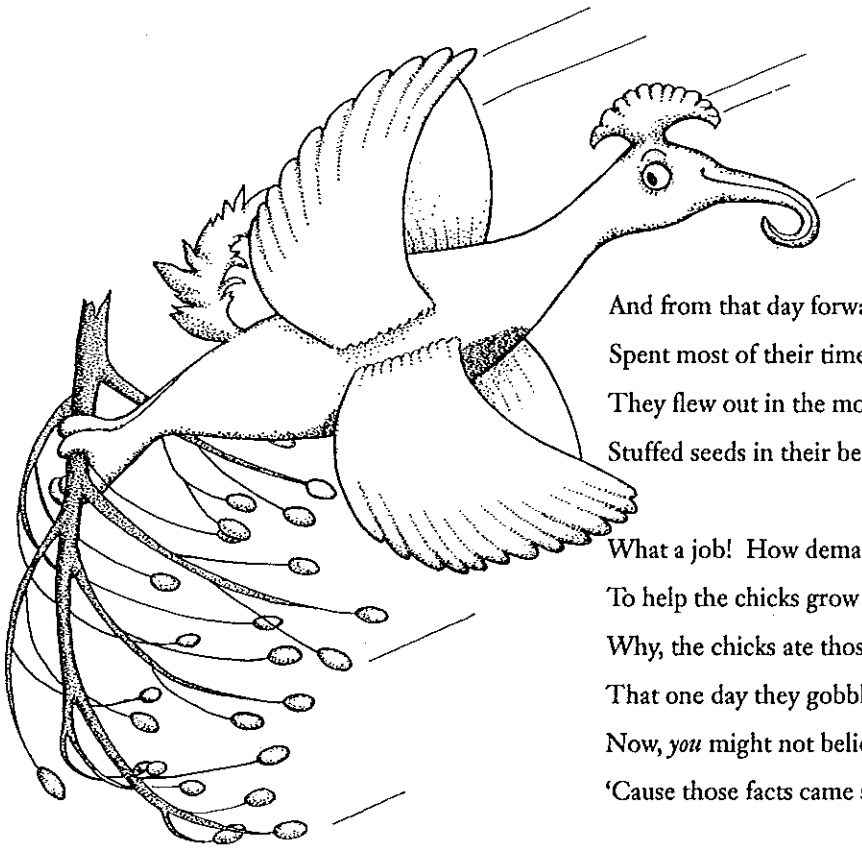
So they scoffed at the seeds, and Jack kept on chewing.
I guess they were right, knew what they were doing!

Now one day as Gertrude perched in the tree
She suddenly felt a twitch in her knee.
The twitching and itching grew, and it grew
Her face turned yellow and purple and blue
And she started to think she was losing her legs
When in fact, she was... yes!... she was laying some eggs!

The first two were yellow, all shiny and new.
The next two were purple, the last two were blue.
And Jack, with a smile, nestled down in the nest
And all winter and spring, warmed the eggs with his chest.

Finally, one morning, the 13th of May,
Gertrude said, "Honey, today is the day!"
And the eggs, how they rattled, the shells how they cracked!
And six baby birds appeared under Jack.
Two were blue, two were purple, and two were bright yellow,
Half had red on their back, half had red on their bellow.





And from that day forward, young Gertrude and Jack
Spent most of their time flapping forward and back,
They flew out in the morning, gathered up food,
Stuffed seeds in their beaks, and returned to their brood.

What a job! How demanding! It took all day long
To help the chicks grow to be healthy and strong.
Why, the chicks ate those berries at such a fast rate
That one day they gobbled six hundred and eight!
Now, *you* might not believe that, but I'd bet on my life,
'Cause those facts came straight from old B. J. McFife!

And B. J. says it's true that those Birds of Zazurds
Would not stop at seconds or even at thirds,
They would always eat fourths and usually fifths
And one bird, once, had seventy-sixths!

So Gertrude one day developed a plan
To speed up the process of feeding her clan.
She stopped stuffing berries inside of her cheeks
And instead plucked whole branches off trees with her beak.

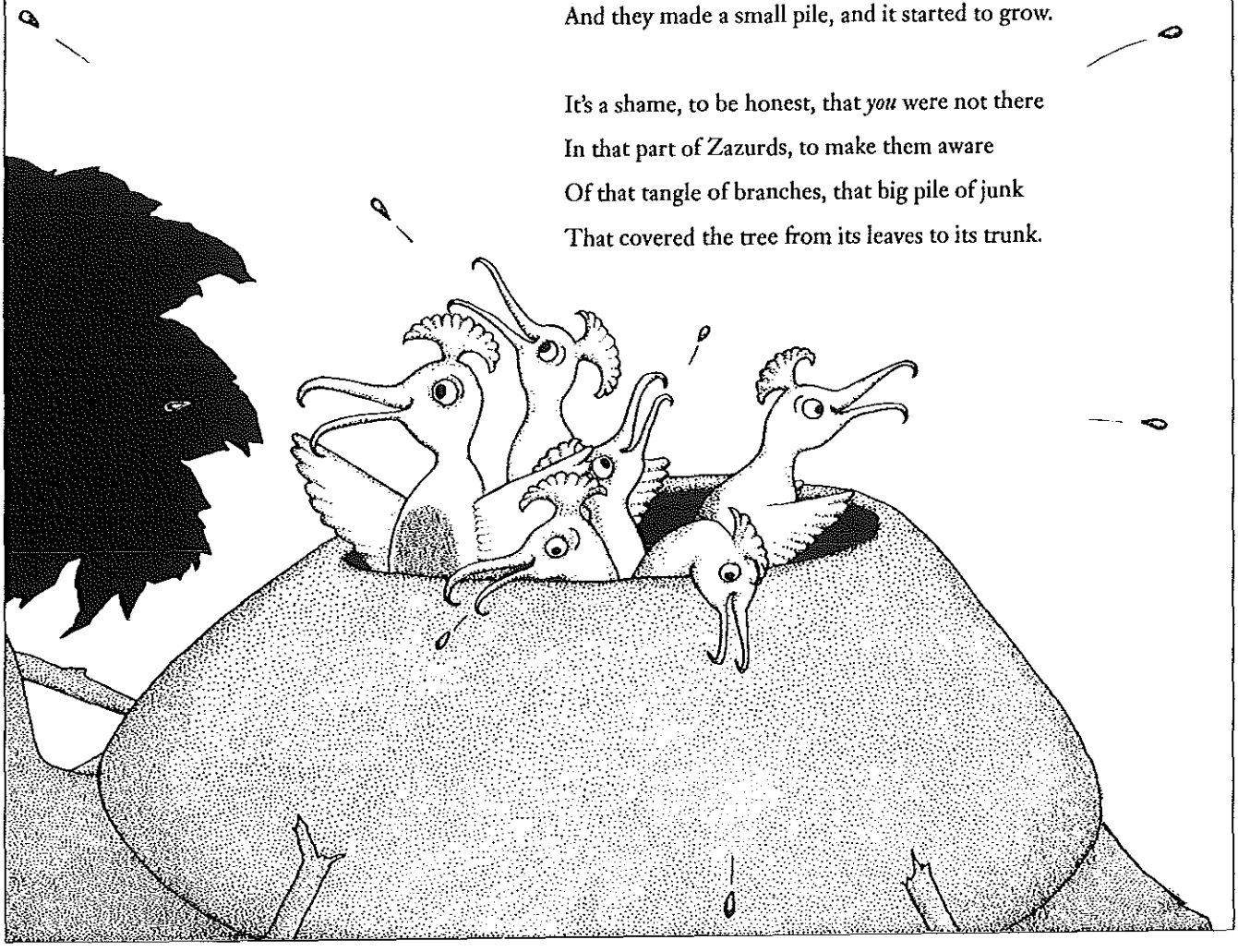
Then she could fly with the branch in her feet,
The limbs trailing ahead, as she flew in retreat.
Sometimes the branches would hold fifty berries!
Enough to feed all of her chicks in one carry.

And though this was handy, though it saved lots of time,
I'll bet there's a question that weighs on your mind:
"What did they do with the branches and seeds
Left at the end of their whole-family feeds?"

Well, the little birds did what their Daddy would do:
They spit out the seeds with a loud, "Puh-puh-TOO!"
And they threw all the branches right out of the nest,
Without really knowing where they all came to rest.

But I'll bet *you* know! You know where they landed!
They got caught in the Gulligutt tree, and were stranded.
They stuck to the limbs of the tree down below,
And they made a small pile, and it started to grow.

It's a shame, to be honest, that *you* were not there
In that part of Zazurds, to make them aware
Of that tangle of branches, that big pile of junk
That covered the tree from its leaves to its trunk.



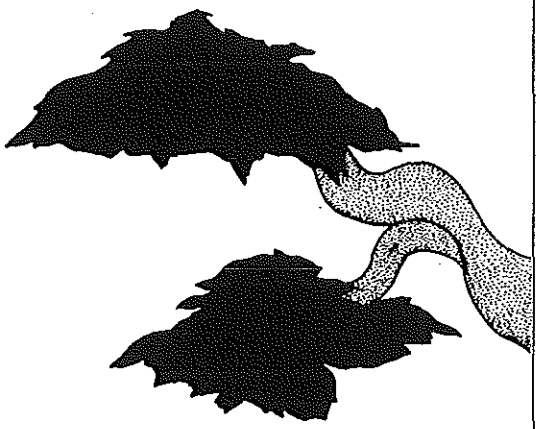
Then you could have said, "What a terrible mess!"
And demanded they clean it, though I must confess
I'm not sure those messy old Birds of Zazurds
Would have paid much attention to anyone's words.

They would surely have smiled and thanked you profusely
And said to themselves as they brushed you off loosely,
"Why should we worry? What is there to fear?
A few little sticks? We see no trouble here!"

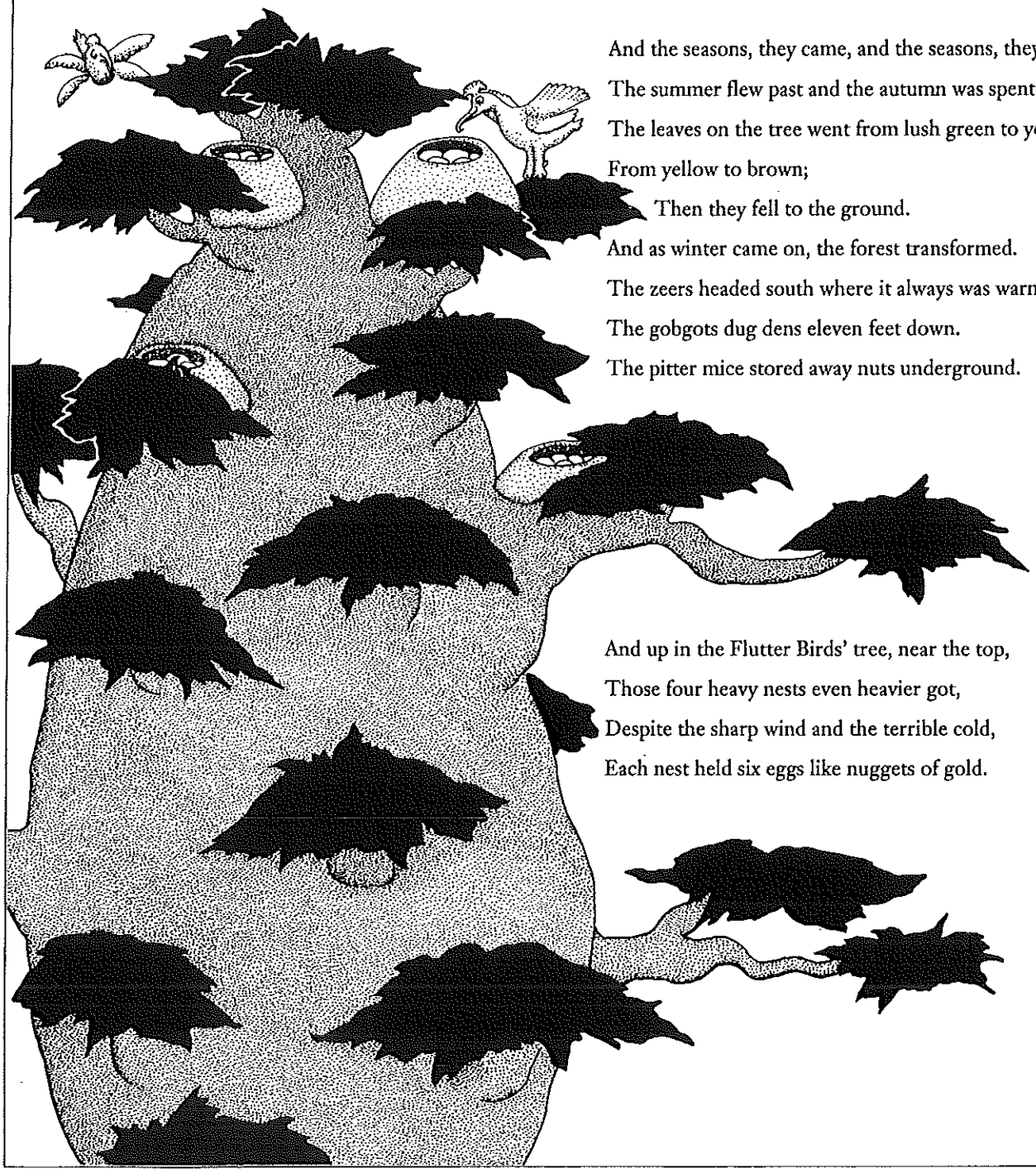
So Gertrude and Jack brought more branches back.
It saved lots of time, which let them relax.

BREAK FOR DISCUSSION (optional)

Well, those young Flutter Birds were not young for long.
Their bodies grew solid, their feathers grew strong.
And soon, one by one, they leaped from the nest,
Thrust forward their feet, and puffed up their chests,
They flapped all four wings and let out a cry
And fluttered away in the blue Zazurds sky.



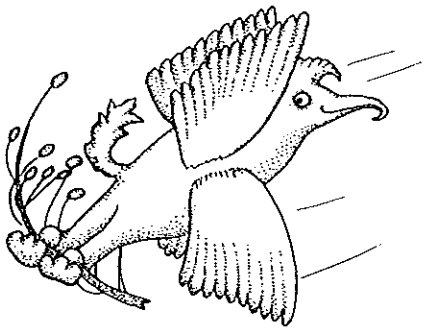
So I asked McFife if Gertie and Jack
Were afraid that their children might never come bac
But B. J. said, "No! Not afraid in the least!
Did you forget? From Southwest to Northeast,
No other tree in the world could support
The weight of a nest of the Flutter Birds' sort.
So those young Flutter birds would as surely be back
As their mother was Gertrude, as their father was Jack."

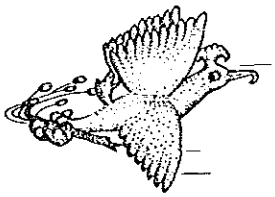


And B. J. was right, all the young birds returned
And Gertrude and Jack were quite unconcerned.
And those two proud parents were happy to see
That several new nests soon appeared in the tree.

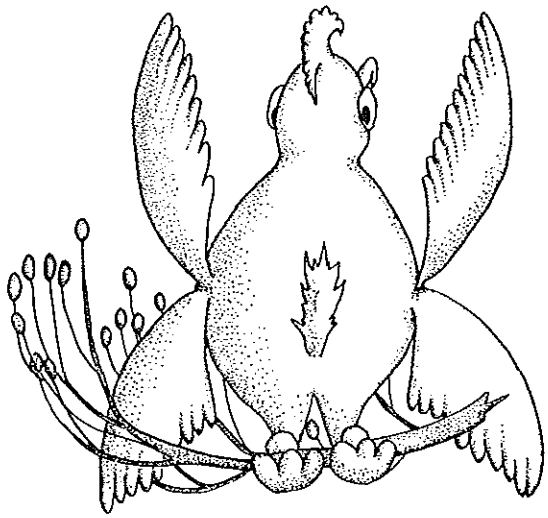
And the seasons, they came, and the seasons, they went.
The summer flew past and the autumn was spent.
The leaves on the tree went from lush green to yellow,
From yellow to brown;
Then they fell to the ground.
And as winter came on, the forest transformed.
The zeers headed south where it always was warm.
The gobgots dug dens eleven feet down.
The pitter mice stored away nuts underground.

And up in the Flutter Birds' tree, near the top,
Those four heavy nests even heavier got,
Despite the sharp wind and the terrible cold,
Each nest held six eggs like nuggets of gold.



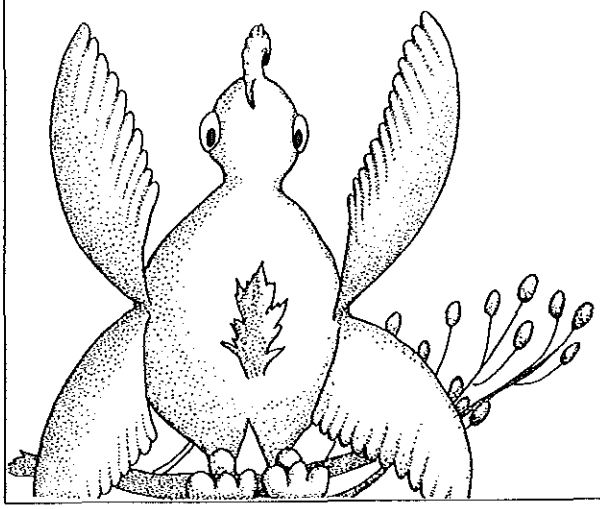


And when springtime returned and brought back the zeers,
When the gobgots woke up and the mice reappeared,
Those Flutter Birds' eggs all trembled, all cracked,
And made proud grandparents of Gertrude and Jack.



Then the forest was filled with melodious peeps
With melifluous chirps and harmonious cheeps
You could hear that marvelous noise throughout Zife,
Or so says my neighbor, old B. J. McFife.

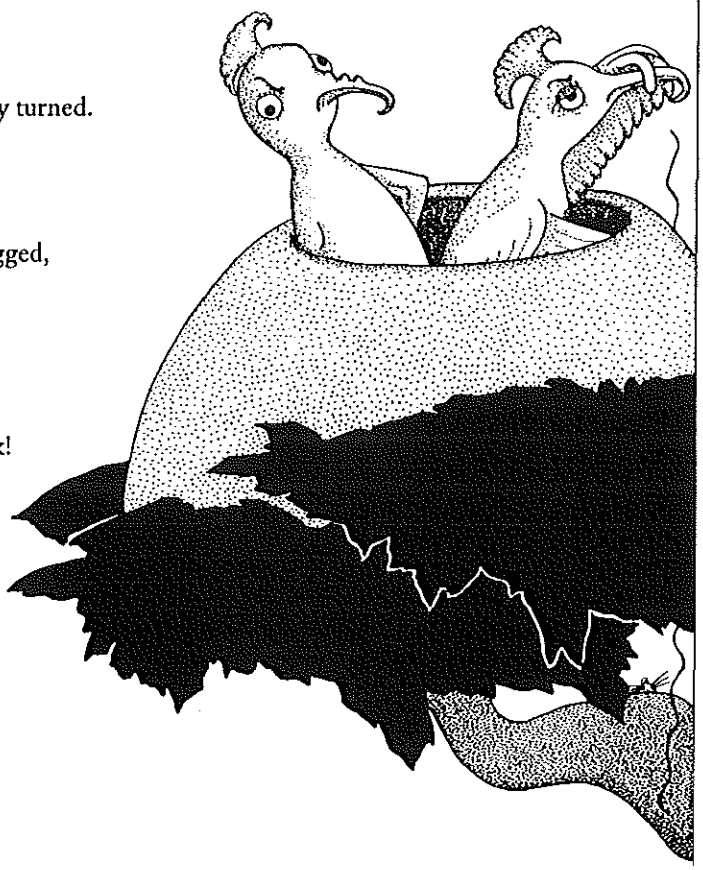
And now all the mommies and now all the daddies
Flew out to find took-a-took seeds for their laddies
They carried back branches, they carried back sticks
Which were bursting with berries and heavy, like bricks!



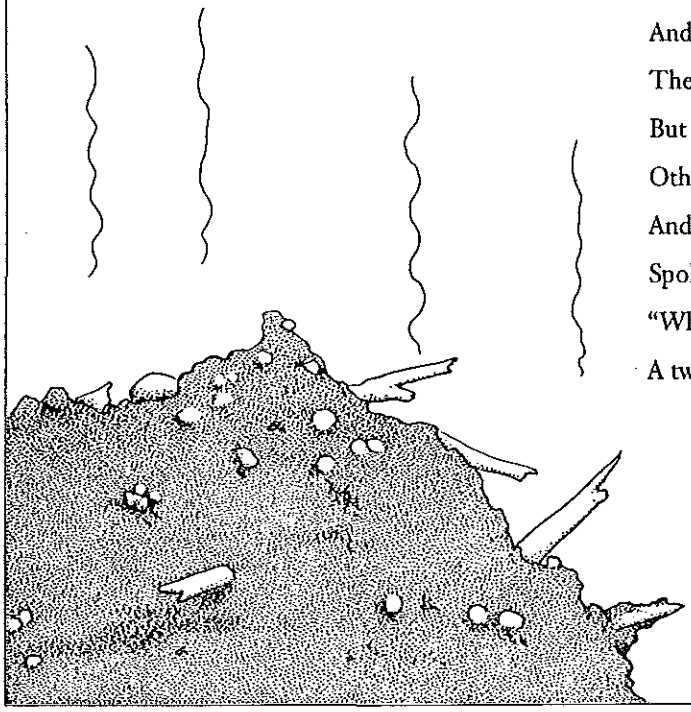
And when the birds finished with chewing their food,
They spit out the seeds —which *I* think is quite rude—
And they threw down the stems without thinking at all.
Now, the pile beneath them was no longer small.

And sometime that summer, the new generation
All learned how to fly, all flew off in formation
And nobody worried, they all soon returned,
And they all built their nests, and the seasons, they turned.

Fall brought the colors and winter brought eggs,
Spring brought new chicks who hungered and begged,
And summer brought plenty of berries and play
And though I hate to admit, I really should say...
That terrible, horrible thicket of junk,
Well, it grew, and it grew, and it grew, and it stunk!



And that's how it went, just exactly like that,
The year after that, and the year after that!
The birds built their nests, the junk pile got fat,
The year after that, and the year after that.



And each year there were birds who would look at the pile,
They would look at the seeds, now rotten and vile,
But before they could shout, "This pile's a disaster!"
Other parts of their brain would work slightly faster
And remember the words from many years back
Spoken by great-great-great- grandfather Jack:
"Why should we worry? What is there to fear?
A twenty-foot pile? I see no trouble here."

But....
I guess they were wrong! They didn't know squat!
What they did to that tree was not right. It was not!

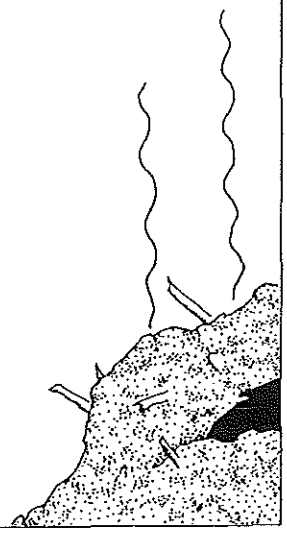
And I wonder what ancestors Gertrude and Jack
Would have said if they'd heard the terrible CRACK!
Would have said if they'd seen the tree leaning back
Would have said if they'd seen all those branches go slack.

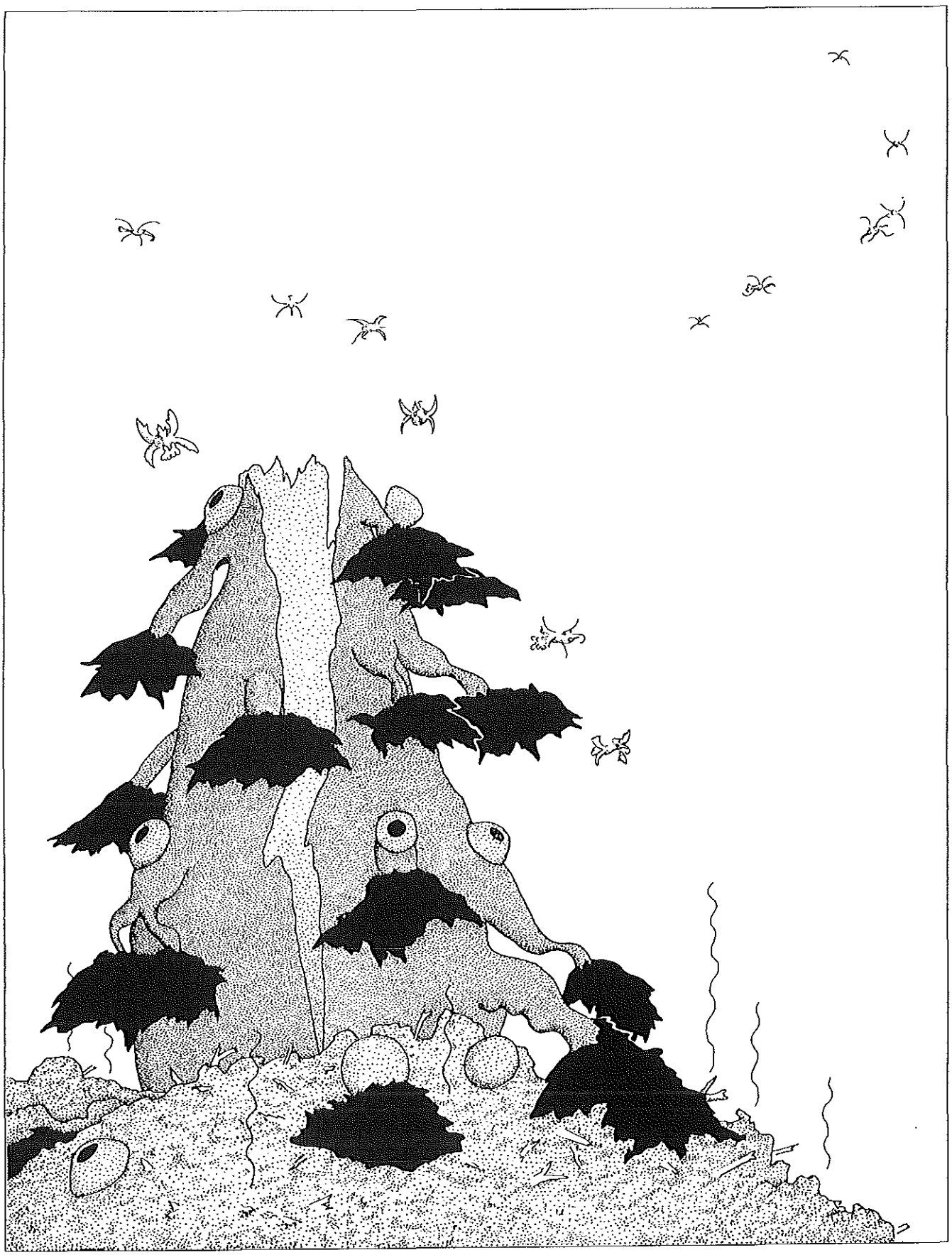
It just was too much! Too much weight weighing down!
It's a wonder that tree didn't fall to the ground!
But fall it did not! It stood right in its place
Now, without the same strength and without the same grace.

But that crack was a warning to those Birds of Zazurds
A warning that 20 foot piles are absurd!
And they'd better get working to clean up their mess
Before worse things occurred and the problem progressed.

So they did get to work, they heeded the warning,
They made up their plans that very same morning.
They all stopped their playing, stopped flying, stopped eating,
They flocked to the tree and they held a great meeting.

BREAK FOR DISCUSSION OF POSSIBLE SOLUTIONS





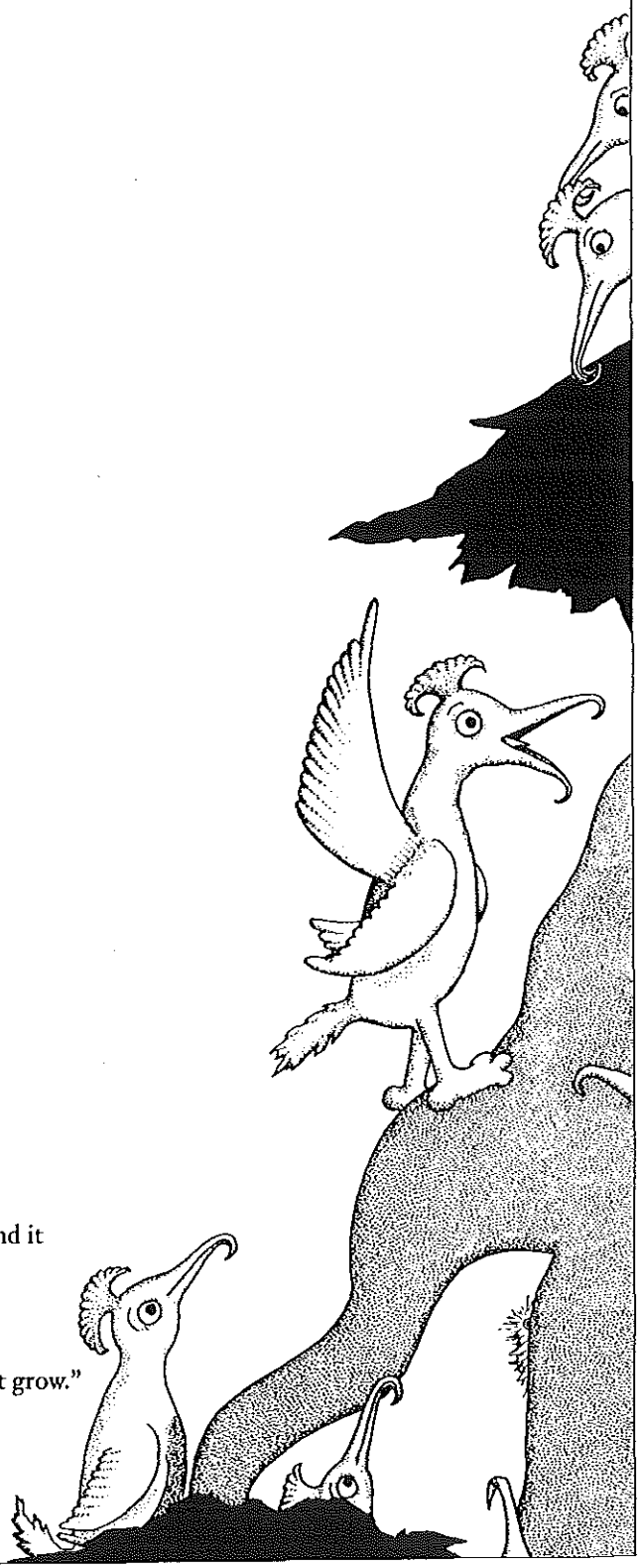
Now the first plan was brilliant, it came from a bird
Named Jack Junior Jack Junior Jack Junior the Third
And Jack was descended completely directly
(You've probably already guessed it correctly)
From the very first Gertrude and very first Jack
Who settled that tree oh so many years back.

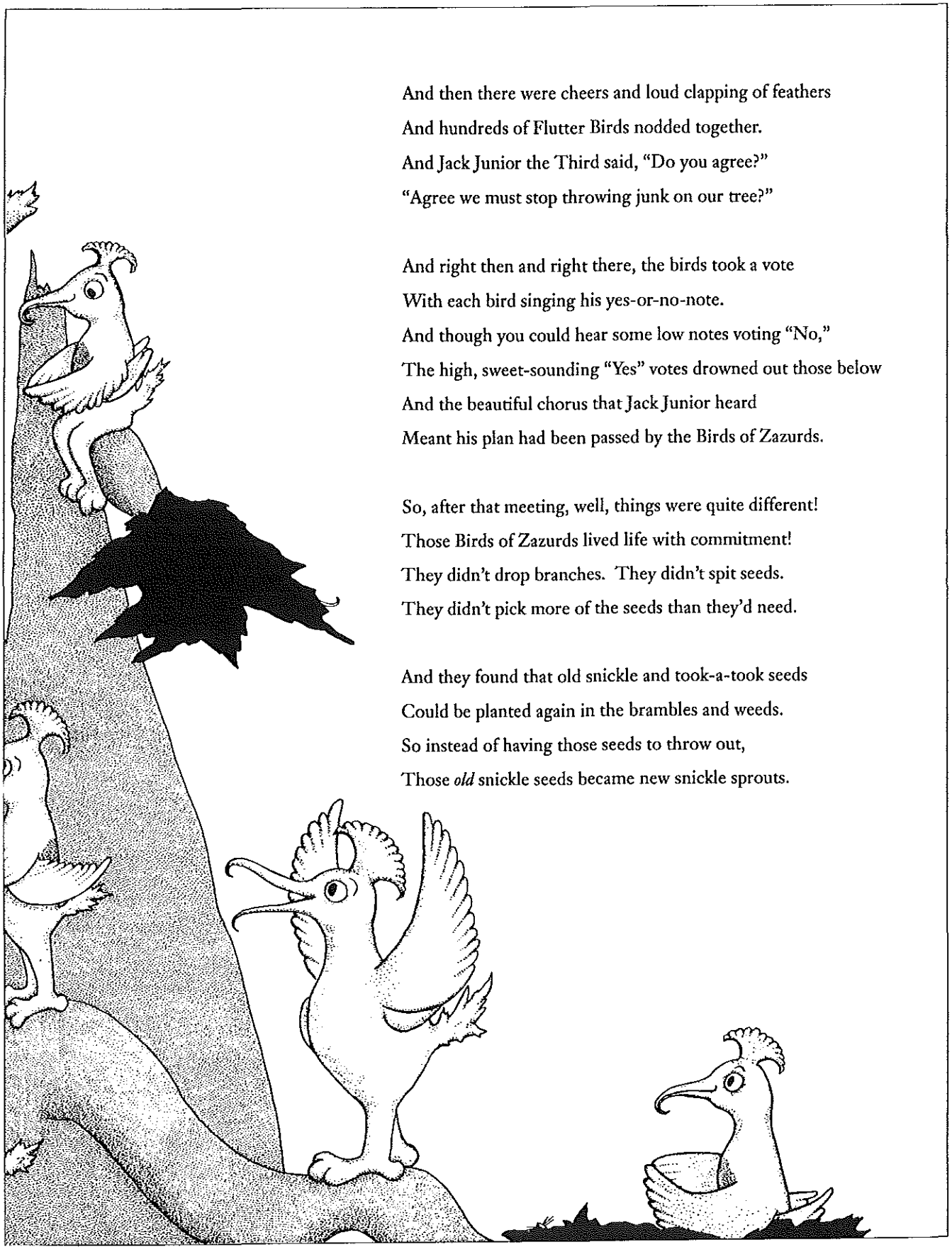
And Jack Junior the Third spoke to all of the birds
And he spoke very loud so his words could be heard.
He said, "Friends, the first thing I'll tell you today
Is that we must change how we throw things away!"

"Spitting out seeds is a thing of the past!
Throwing out branches must end now, at last!
For all of this time it has seemed to be free
To throw all our junk on our Gulligutt tree."

"But free it is not! It has a huge cost
Our very own Gulligutt tree may be lost!
And in some parts of Zife, the forest is bare
And took-a-took plants have become downright rare."

"So I say to you all, my family and friends,
This is the plan that I now recommend:
Don't pluck off a *whole* branch of took-a-took seeds,
Only take a small twig with the seeds that you'll need.
And the leftover branch? Clamp your beak right around it
And return it right back to the place that you found it!
Then the thicket of junk that lurks down below
Won't expand, won't increase, won't enlarge, and won't grow."





And then there were cheers and loud clapping of feathers
And hundreds of Flutter Birds nodded together.
And Jack Junior the Third said, "Do you agree?"
"Agree we must stop throwing junk on our tree?"

And right then and right there, the birds took a vote
With each bird singing his yes-or-no-note.
And though you could hear some low notes voting "No,"
The high, sweet-sounding "Yes" votes drowned out those below
And the beautiful chorus that Jack Junior heard
Meant his plan had been passed by the Birds of Zazurds.

So, after that meeting, well, things were quite different!
Those Birds of Zazurds lived life with commitment!
They didn't drop branches. They didn't spit seeds.
They didn't pick more of the seeds than they'd need.

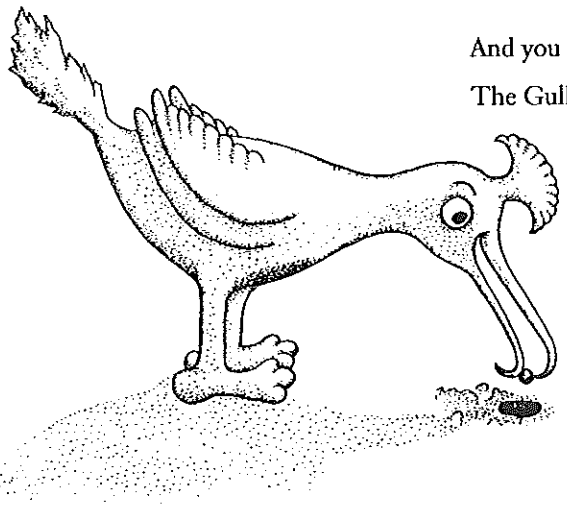
And they found that old snickle and took-a-took seeds
Could be planted again in the brambles and weeds.
So instead of having those seeds to throw out,
Those *old* snickle seeds became new snickle sprouts.

And the Birds of Zazurds planted every last seed
That once had been stuck to their Gulligutt tree
So that snickle and took-a-took plants did abound
And they covered the forest for miles around.

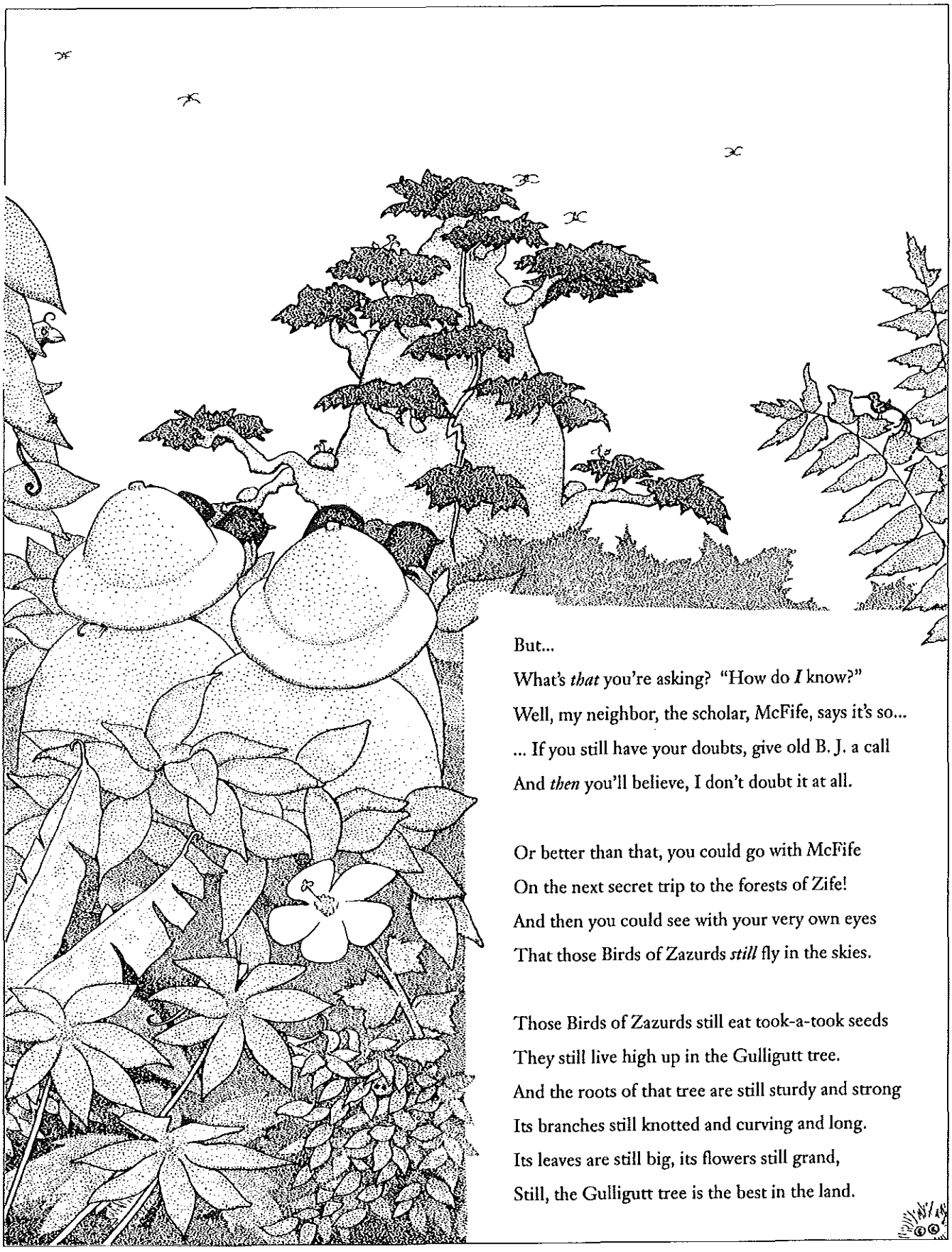
And it took a long time; it took several years
But soon all the Gulligutt branches were clear!
And then, after that....Well, would you believe?
The Gulligutt tree heaved a sigh of relief
And the Birds of Zazurds, well, they started to sing,
For they knew they had done the exactly right thing!

Then the birds sang quite often, they sang sweet and loud
They sang mostly because they were happy and proud.
By working together, by having a plan,
They had rescued their tree, they had rescued their clan!

And one day when Flutter bird Gertrude FlipFlupper
Was planting some seeds leftover from supper,
She fluffed up her feathers and threw back her head
And with pride in her voice, she truthfully said:
"No reason to worry! No reason to fear!
The pile is gone! There is no trouble here!"



And you know, she was right! There was nothing to fear.
The Gulligutt tree was out in the clear.



But...
What's *that* you're asking? "How do *I* know?"
Well, my neighbor, the scholar, McFife, says it's so...
... If you still have your doubts, give old B. J. a call
And *then* you'll believe, I don't doubt it at all.

Or better than that, you could go with McFife
On the next secret trip to the forests of Zife!
And then you could see with your very own eyes
That those Birds of Zazurds *still* fly in the skies.

Those Birds of Zazurds still eat took-a-took seeds
They still live high up in the Gulligutt tree.
And the roots of that tree are still sturdy and strong
Its branches still knotted and curving and long.
Its leaves are still big, its flowers still grand,
Still, the Gulligutt tree is the best in the land.

Discussion

First Discussion Session

After the line ...It saved lots of time which let them relax.

1. What are the major problems facing the Birds?
2. Who (or what) is responsible for these problems developing?
3. What do you think might happen next?

Second Discussion Session

After the line ...They flocked to the tree and they held a great meeting.

1. Why are the Birds having a meeting?
2. What are the problems now? (add ideas to the list)
3. What solutions do you think will help the Birds?

Final Discussion

If there was no discussion during the story, use the factual questions above to begin the final discussion.

● Beginning

1. What things did the Birds do to create their problem?
2. Was there a problem when there was only one nest? How did more nests and more birds make the problem worse?
3. What were the other problems facing the Birds?
4. What solutions did the Birds devise? Were they the same as yours? What other suggestions would you have for the Birds to solve their waste problem?
5. Why was it important for the Birds to change the way they threw things away? What other things did they have to do differently? Why wouldn't it have worked to have someone just take the mess "away"?
6. How did the solutions to the problems change the Birds' lives? Did it make their lives easier or harder? Was their life better? How?
7. What was special about the Gulligutt tree? Why did the young Birds return to the tree?
8. How are the Birds of Zazurds like people? How is the Gulligutt tree like your school? Your home? Your town?
9. Do people in your classroom (your school, your family) do things that might harm your Gulligutt tree?

■ ◆ Intermediate and Advanced

1. When did the Birds' trash become a problem? Why wasn't it a problem before that?
2. So, was Jack right at the time when he said, "I see no problem here."?
3. What were the effects of increasing population?
4. How did the Birds' behaviors make their lives easier?
5. What solutions did the Birds devise? Were they the same as yours? What other suggestions would you have for the Birds?
6. How are the Birds of Zazurds like people? How is the Gulligutt tree like our homes and community?
7. How are the trash problems of the Birds like the problems people face?
8. What can we learn from the Birds of Zazurds?
9. If you went with B.J. McFife on his next secret trip to Zazurds, what do you think you would find? How might the Birds have changed since the end of the story?
10. Where do you think Zazurds is? Where is Zife? Who do you think B.J. McFife is?
11. Describe the narrator. How is the narrator like you?
12. Who is your favorite character? Why?

Our School, the Gulligutt Tree

The Birds of Zazurds

Overview

This is a project where students make drawings to compare the Gulligutt tree and their school. The drawings show how the Birds of Zazurds and people dispose of their waste.

Level

● Beginning

Materials

drawing paper

crayons

Objectives

Students will compare the Gulligutt tree to their school and identify wasteful behaviors.

Management Suggestions

1. Arrange a short "field trip" with the custodian to the dumpster and recycling area so students can see where the classroom (cafeteria, teacher's room, office) trash goes. Have the custodian describe where the trash goes from there.
2. Use the discussion following the story to focus the ideas for the drawings.
3. Consider doing small group drawings or a single class mural.

Procedure

1. Read the Birds of Zazurds and discuss the story using the discussion questions.
2. On a flip chart or on the board, make two columns: on one side brainstorm a list of items the Birds threw away, on the other side make a list of things that are thrown away in the school. Compare the lists and discuss similarities.
4. Take a quick trip with the custodian to see where trash from the classroom (and other parts of the school) goes. Are things being done to reduce the amount of trash thrown out?
5. Have students fold drawing paper in half. Label one side "The Gulligutt Tree" and the other side "Our School." Have them draw/color the tree and the school showing the trash produced and disposed of in both places.

Discussion

1. Compare the Gulligutt tree to the school.
2. How are the Birds' habits and your habits similar? Different?
3. How are the tree and the school important "habitats"? Why do we need to care for them?
4. What waste problems do we have in the school?
5. The Birds changed how they did things. Are there things we could do differently?

The Birds of Zazurds Play

Level
■ *Intermediate*

Materials
costumes and props the students devise

Overview
Students dramatize the Birds of Zazurds and put on a play for younger classes.

Objectives
Students will interpret the story of the Birds of Zazurds, relate the story to their own lives and produce a play which demonstrates their understanding.

Management Suggestions
1. Arrange (or have students arrange) with other teachers to perform the play for younger classes in the school. The play might be presented to parents or taken "on the road" to other schools.
2. Avoid writing out lengthy scripts by making copies of the story. Have narrators and characters underline their lines.
3. More advanced groups may want to write more dialog into the story.
4. Try to have a part for each student. Several students can share the part of the narrator.

Procedure
1. Read the story and discuss it to process student understanding of the allegory and help the students relate the Birds to their own lives.
2. Plan the play with students:
   - List the characters
   - Decide who will take each part, including narrator(s) and "extras"
   - Divide the story into "scenes"
   - Brainstorm ideas for props and costumes that would go with each scene
   - Decide on what dialog will be included in each part
   - Experiment with actions that can convey meaning to the story
3. Gather props and costume materials.
4. Practice the play and logistics for putting the play on for others.
5. Plan for discussion with the audience following the play - have students plan appropriate questions.
6. Present the play and facilitate discussion with the audience.

Discussion
1. Discuss how the students' understanding of the story has changed after presenting the play to other groups.
2. Brainstorm action steps the students might take to avoid developing problems with waste in school.

Zazurds II

Overview

Students write and illustrate a sequel to the story Birds of Zazurds.

Level

◆ ***Advanced***

Materials

materials for writing and drawing

Objectives

Students will analyze the Birds of Zazurds and create a story line which develops the concepts of waste management into another time.

Management Suggestions

1. Arrange (or have students arrange) with other teachers to present their stories to younger classes in the school.
2. To help students understand allegory, have them read and discuss other environmental allegories (for example, The Lorax and the Butter Battle Book by Dr. Seuss).

Procedure

1. Read the Birds of Zazurds and discuss the story to process student understanding of the allegory, and to analyze the waste management issues presented. Discuss how the problems evolved, what attitudes were responsible for the problems that developed, and how the problems were addressed. Analyze the characters, discuss how realistic they were, and how they could represent people.
2. List additional waste management issues students are familiar with that were not mentioned in the story. Imagine how these issues might be described in a Zazurdian (allegorical) setting.
3. Discuss imaginary scenarios that could take characters or situations into the future, or before the time of the story. It may be helpful to start by taking an imaginary trip with B.J. McFife back to Zife. Students might imagine either a land where problems continue to be dealt with successfully, or where characters create new waste problems. Behaviors of any of the other animals mentioned in the story could be developed and those animals could interact with the Birds. Consider the same story from the Gobgot's point-of-view, or as it might be told by B.J. McFife.
4. Have students write their sequels in prose or verse. Work individually, in pairs, or in small groups. develop illustrations to accompany the story.
5. Edit and revise the works.
6. Read and discuss the sequels in class to further develop students' understanding of the issues and ideas for solving waste problems.

Follow-up

1. After the writing has been edited and discussed in class, students can read both the Birds of Zazurds and the sequel to younger classes, and lead discussions following the stories.
2. Discuss student understanding of the waste management issues after having presented to other groups.
3. Brainstorm action steps the students might take to avoid developing problems with waste in school, at home, and in the community.

Awareness Pathways

Part 1: What Is the Problem?

These activities help students answer the question, "What is the waste problem?" They look at the volume of trash production, lifestyles that contribute to the waste problem, American consumption and resource use.

Drop in the Bucket ● ■ ◆ 36

How Much Trash? ■ ◆ 38

Mounting Milk Cartons ● 40

If Toys Could Talk ● ■ ◆ 42

Bread & Kisses ■ ◆ 44

Getting to the Route of the Hazardous Waste Problem ■ ◆ 46

Part 2: Can I Make a Difference?

These activities help students identify their roles in waste problems around them, and help them see some of the possible solutions. Students look at decision-making and relate their decisions to actions they can take.

Everyday Choices for a Sustainable Future
(Moving Toward Waste Reduction and Pollution Prevention) ■ ◆ 48

For Better or Worse ■ ◆ 54

Are Ten Better Than One? ● ■ 56

Paper, Plastic, or Cloth ■ 58

Where'd You Get That Can? ■ 69

Test the Alternatives ● ■ 70

Awareness

Drop in the Bucket

Level
- ● Beginning
- ■ Intermediate
- ◆ Advanced

Materials
large metal wastebasket or other metal container (a washtub is ideal)

1 lb. dry split peas

5 lbs. dry kidney beans

chart with data

cups labeled individual, classroom, school, town, state for holding beans

Key Question
What difference does my trash make?

Overview
In this demonstration a single pea represents the waste created by an individual daily, and a bean represents the waste created by about 200 people. As peas and beans are dropped into a large hollow container, students get a powerful auditory image of the waste disposed of daily in their school, town, and state.

Objective
Students will compare the amount of trash produced by an individual, a school, a community, and Maine through a concrete auditory model.

Background Information
It is easy to feel like each of us is only a "drop in the bucket" when it comes to the waste problem. The waste each person throws out every day may seem insignificant. But when we look at the accumulation of waste from a larger group, with each person producing 4.3 pounds every day, trash piles up quickly. This table shows how the trash problem is magnified when we look at groups around us.

Daily Waste Generation by Group

	Population	Daily Waste	Pieces of "trash"
Individual Person	1	4.3 pounds	1 pea
Class: Small	18	77 pounds	15 peas
Class: Large	28	120 pounds	24 peas
School: Small	200	860 pounds	1 bean
School: Large	500	1 ton	1 bean
Town	15,000	32 tons	32 beans
City	100,000	215 tons	215 beans
State (Maine)	1,250,000	2,700 tons	2700 beans
Country (U.S.)	265,000,000	530,000 tons	530,000 beans

In this activity each pea represents about five pounds of trash and each bean represents a ton of trash.

Management Suggestions

1. ● **Beginning** - Prepare the peas and beans ahead of time for the children to count. Mark each cup with the name of the group, the number of pieces, and what each piece represents. You may want to count the peas and beans ahead of time.
2. ■ ◆ **Intermediate & Advanced** - Students can prepare the peas and beans themselves. They should mark their cup with group name and scale.
3. Make a chart with the data that represents your school from the chart above, adding the name of your class, school, and town. ■ ◆ **Intermediate & Advanced** - You might have the students calculate the numbers of "pieces of trash" themselves, rounding to the closest pea or bean.
4. Post the chart so each group can check the number of items it needs to count.
5. Place the wastebasket so it reverberates when the beans are dropped; make the sound as dramatic as possible by pouring the beans very slowly. Some teachers have increased the sound effects by using BBs instead of beans and staples (close the points by stapling "nothing") instead of peas.
6. There are great opportunities here to work on estimating, averaging, graphing and large numbers. Can this be integrated with your math lesson?

Procedure

1. Discuss how much trash each person makes in a day. Read the chart and compare the numbers for each group. Discuss the phrase "drop in the bucket."
2. Divide the class into small groups, each to count out the appropriate number of beans or peas.
3. Have each group find the number of beans or peas to count, according to the chart.
4. Have the groups count the number of beans or peas and collect them in the appropriate cup. Be sure each cup is labeled.
5. Identify each cup and discuss how much trash each pea or each bean represents.
6. Seat students close to the wastebasket; ***have them close their eyes.***
7. Announce what the cup represents, e.g. "This sound represents the waste produced every day by each one of us;" ***slowly*** pour the pieces from the cup into the wastebasket.
8. Repeat for the other cups.

Discussion Questions

1. After all the cups have been poured, elicit student reactions to the different sounds, compare amounts of waste generated by various groups in Maine.
2. Does it matter what one person throws away? How?
3. How can an individual, a class, a school, or a town make a difference in how much waste is produced and has to be disposed?

Related Pathways

1. Follow up this activity, along with ***How Much Trash***, by inviting your community recycling coordinator or public works director into class to discuss how much trash your community generates and where it goes. It is sometimes a good idea to provide outside experts an advance list of questions you would like answered, and students can help with this.

Awareness

How Much Trash?

Level

■ *Intermediate*

◆ *Advanced*

Materials

scale

box for weighing trash

large bag of assorted, clean trash

calculator

plastic trash bags

Key Question

How much waste am I responsible for?

Overview

In this activity, students weigh 4.3 pounds of trash to see how much they generate each day. They pile bags to show how much trash the class as a whole generates in a day and they estimate the accumulated volume of the trash they would produce in a year.

Objectives

Students will show how much trash they are each responsible for producing every day; they will calculate the amount of trash generated in the U.S., Maine, and their community daily and annually; they will analyze the effect of source reduction.

Background Information

Municipal Solid Waste (MSW) includes trash that is thrown away by households and businesses. It does not include industrial, agricultural or mining wastes. In Maine, MSW includes paper, food wastes, metals, yard/wood wastes, plastics, glass, litter/diapers, textiles, demolition debris and "other". The U.S. Environmental Protection Agency estimates that each person in the country contributes an average of 4.3 pounds of MSW daily. This translates to over 3/4 ton in a year per person. How much is a ton? How much space does our trash take up? How much of the trash can be recycled?

Management Suggestions

1. If you have not already sat down with the school custodian, the principal, the lunchroom staff, and other school personnel to discuss your work with *Pathways*, it is important that you get them involved

Municipal Solid Waste Generated & Recycled

(annual figures; ppd = pounds per person per day)

	U.S. (EPA 1991)	*Maine (MWMA 1992)*
MSW 1960	88 million tons (2.7 ppd)	n/a
MSW 1988	150 million tons (4.0 ppd)	1.36 million tons
MSW 1990/91	195.7 million tons (4.3 ppd)	1.25 million tons
Recycled 1988	11 %	16 %
Recycled 1991	17.1 %	30 %
Goal for Recycling 1994/95	20-30 %	50 %

(Detailed statistics of waste generation and recycling are available from the U.S. Environmental Protection Agency and state waste management agencies. Because different agencies include different types of waste in the same type of calculation, it is often difficult to make complete, direct comparisons between states and the United States as a whole.)

in the project before you and the students begin to gather trash. Such communication never fails to prevent misunderstanding and generate good ideas.

2. Is there a way for students to save the "trash" they generate in school for a week leading up to the activity? Be specific about what they should save (paper, lunch wrappers, pencil shavings, disposable containers) and what they should not (tissues, food). This will supply some of the trash needed in the activity.
3. The activity will be greatly enriched if there is a 4.3 lb. bag of trash for each student *and/or* if trash at home can be sorted, collected, and weighed. Talk over the logistical and communications challenges with the principal and a few key parents. Perhaps it will be a good solution to send an empty trash bag home with a note explaining the activity and assuring parents that bringing a 4.3 lb. assortment of trash from home is completely optional.
4. Prepare a chart or a transparency with data that students can use to get information for calculations. Contact your State's waste management or planning agency for updated information on MSW generated and recycled.

Procedure

1. Weigh the empty box; if possible adjust the scale to zero with the box in place.
2. Have the students estimate how full the box would be with 4.3 pounds of trash.
3. Students take turns adding to the box until the scale reads 4.3 pounds. This is how much trash each American is responsible for discarding each day.
4. Put the trash into a plastic bag (if possible put a similar amount of trash into bags, one for each student). Estimate how large a pile of bags the whole class would produce each day. How many Escorts would this be?
5. Estimate how large the pile would be in a week; a year.
6. Calculate how much waste your family generates in a day, week, year.
7. Take a "field trip" to the school dumpster. How often does it get emptied?
8. Calculate the weight of the students in the class in tons. How many students does it take to make a ton?
9. Estimate figures of trash production (in tons) for the whole school, town, state, country for a day. Compare to the size of the class.
10. Repeat for a week, for a year.
11. If 50% of Maine's MSW is recycled, how much trash will be eliminated from the waste stream this school year?

Discussion Questions

1. Where does the waste from the school get taken? How much of it is recycled?
2. Talk about all of the types of waste your family generates. (Make a list in your journal.) How is waste at home different than waste at school? How much of the waste produced at home is recycled?
3. Can schools and families recycle anything that they want? What recycling facilities does your town provide?
4. How is the waste your family generates different from the waste your Mom and Dad's family generated when they were growing up?
5. Is each person in fact responsible for 4.3 pounds of trash per day? Where does this number come from? Why are some persons responsible for *more* than 4.3 lbs. per day and some for *less?*
6. ◆ Some people think that we should avoid talking about leftover materials as "waste" or "trash" and begin to think of them as "resources" What is your opinion?

Related Pathways

1. Invite the school custodian to discuss the amount of trash the school generates each day, and where it goes. Would it be possible for a few students to accompany the custodian as trash is collected and disposed of? Also consider talking with the custodian about the **assessment pathway School Waste Audit.**

Adapted and rewritten from the Waste Away curriculum with permission from the Vermont Institute of Natural Science, PO Box 86, Woodstock, VT 05091; (802) 457-2779.

Awareness

Mounting Milk Cartons

Level
● Beginning

Materials
milk cartons (rinsed and drained) collected school-wide for a day (week)

large roll paper for tracing student body shapes

markers

glue for attaching cartons to paper

Key Question
How fast does milk carton trash accumulate in our school?

Overview
Students collect large numbers of empty milk cartons from the school lunch program and use the cartons for construction projects. They glue the cartons to their body shape outlines and can calculate the number of "carton people" the school creates every day. This gives them concrete images for the amount of trash they help generate, and they see how fast that trash accumulates. They follow-up by considering ways to reduce the waste, not compromise their health by drinking less milk.

Objectives
Students will show how common disposable items become trash that mounts up and must be discarded.

Background Information
Milk is considered an important and healthy staple of the American diet. Elementary school students often drink two half-pint cartons of milk each school day. Although the cartons provide a sanitary, easily handled package for milk, they have many drawbacks. The full cartons take up a lot of delivery truck and refrigerator space. The high level of consumption generates a large amount of non-recyclable trash daily, which needs to be landfilled or incinerated.

Some Maine schools compost milk cartons with other organic cafeteria waste. This is a difficult process, and the plastic coating on the cartons can be a problem in composting.

Maine dairies are exploring alternatives to the disposable plastic coated paper half-pint cartons. Dairies in several states sell alternative half-pint milk packages to schools. One is a returnable, refillable Lexan (plastic) half-pint milk container. The other is a lightweight, recyclable plastic pouch. While there are disadvantages for each of these alternatives, both create less waste and conserve resources. Dairies compete for school milk contracts which makes the industry responsive to consumer demands. Dairies will respond to requests for alternative packaging to reduce waste in school.

Management Suggestions

1. Estimate how many cartons you will need to fill in a student's outline (as many as 60.) Compare this to the amount of milk (and the number of cartons) purchased by the school daily/weekly. Anticipate how long you will need to collect cartons to fill in the outlines of several students.
2. It is more dramatic if enough cartons can be accumulated in a few days or a week (this shows how fast trash is generated.)
3. Collect, rinse, drain, and store milk cartons until enough have been collected.
4. If every student won't get his or her outline drawn, consider how those who get drawn are chosen.
5. **Alternative Projects:** Use a wire frame and string cartons together to make a three-dimensional "carton person", or staple cartons together to make a life-like model. Consider making models of other objects - a house, a truck, a table.
6. The object of this activity is not to get students to drink less milk, but to understand how much waste they help create. Follow up by discussing alternatives to using disposable milk cartons.

Procedure

1. Working in small groups, have students draw their body outlines on large pieces of paper.
2. Estimate the number of milk cartons needed to fill in the body shape.
3. Glue cartons to the paper.
4. Count the number of cartons on a figure. Compare to the estimates.
5. Display the "carton people" in a prominent place in the school. Include some facts about how much of the school trash is made of milk cartons. Keep a running tally of the "number of cartons used" on a thermometer-type graph.
6. Plan how you will discard the projects when you take the display down.

Discussion Questions

1. How many milk cartons are used in the school in a day? week? Where do the empties go?
2. What are the alternatives to using milk cartons in the school?
3. What do we mean by the word "resource?" What resources are used up if we use disposable containers for our milk? recycled containers? refilled containers?
4. What other disposable packages or items are used regularly in the school? How can this waste be reduced?

Related Pathways

1. When it comes to packaging, different decisions are often made at home and at school. Students might ask parents why they buy milk in large containers while the school uses tiny ones. Compare how most homes and schools buy peanut butter. What are the reasons for the differences? What are the effects on the amount of waste?

Awareness

If Toys Could Talk

Level
- ● Beginning
- ■ Intermediate
- ◆ Advanced

Materials
examples (or pictures) of antique toys
examples of modern toys

Key Questions

How have toys changed from the days when our grandparents were young? How was our grandparents' waste different?

Overview

Students bring in toys from home and collect "antique" toys from their parents' and grandparents' childhood. They examine the toys and compare how materials have changed over the years. They draw conclusions about how their lives are different from their grandparents'.

Objectives

Students will compare the products they use today to those used by their parents and grandparents; they will describe how lifestyles in our country have changed over time and how the waste we generate has changed over time.

Background Information

Most products, including toys, have changed significantly over the years. Through the early part of the 1900s most toys were made from natural materials such as wood. Handmade toys like whirligigs, bean shooters, yo-yos, and tops were very popular. Over time, commercially manufactured toys like wooden Lincoln Logs™ and Tinker Toys™ became available. In the 1960s, plastic toys began to dominate the market, and the demand for hula hoops, Frisbees™, Lego™, toy guns, and plastic models increased steadily. Today, battery operated and electronic toys are very popular, along with video and computer games.

Toys are a metaphor for the American waste dilemma. A number of factors, including manufacturing capacity, marketing strategies, and a rising standard of living, have filled American homes with more and more and more toys. Growth in the consumption of toys has not been unlike growth in the consumption of other material goods. Changes in the way toys are made, in what they can do, in the materials used to produce them, and in the number of toys marketed, reflect changes in our society, and they have *produced* changes in our society, including a big increase in solid waste.

Management Suggestions

1. Send a note home to parents, describing the activity, and perhaps listing a few of the questions students have about old-fashioned toys. Provide a space for parents' simple drawings of toys they remember. Older students might prepare this "parent homework" themselves.
   Ask parents for their input. Let them (and the students) know that if for any reason they are uncomfortable about sending in toys –old or new– that pictures or drawings will make a perfectly good substitute.
2. If possible have a grandparent visit school to be interviewed by the children. Have the students plan questions to ask or use the questions below to help with the interview.
3. The toys and pictures of toys will make good objects for a variety of classifying and grouping activities for young children.
4. While the class is looking over this collection of toys, take the opportunity to teach about the 3 R's of waste management: REDUCE, REUSE, and RECYCLE (see discussion question #5).

Procedure

1. Have each student bring to school a broken toy or a toy that will be thrown away and (if possible) a toy used by their parents or grandparents.
2. Discuss which toys are their favorites and why.
3. Divide the toys into groups of "modern" and "old fashioned".
4. Compare the two groups - look at and discuss:

   - What materials are the toys made of?
   - How long did the toys usually last?
   - If they break, can they be fixed?
   - Would it be cheaper to fix the toy or buy a new one?
   - When it could no longer be used, what would happen to it?
   - How many toys do you have, how many toys did your parents (grandparents) have?

Discussion Questions

1. How have toys changed since your grandparents were young?
2. Are there more toys around today than there were when your grandparents were young? Why?
3. What do you do with toys that break? What about toys that you no longer play with?
4. Which kind of toys are the most fun to play with? Do you think your grandparents would have said the same thing? Why?
5. What are some of the things that you could do to make the amount of toy waste smaller?
6. How is the toy problem like the problem with too much waste in town?
7. What can you do to REDUCE the amount of waste that has to be thrown away?

Related Pathways

1. Discussion Question #5 can lead directly to group action projects for even the youngest students. Is there a a toy library in your community? The class might visit, and make donations. What about other ways of donating, sharing, swapping, and fixing?

2. This is an excellent opportunity to get local retired people–whether or not they are grandparents–into your classroom to make a clear contribution. Help students develop interview questions, which could begin with a focus on toys and move outward into many areas.

3. With this introduction other historical topics present themselves. How did schools use and dispose of materials in our grandparents' time? restaurants? manufacturers?

Adapted from AVR Teacher's Resource Guide (1990) with permission from the Association of Vermont Recyclers, PO Box 1244, Montpelier, VT 05601; (802) 229-1833.

Awareness

Bread and Kisses

Level
■ *Intermediate*
◆ *Advanced*

Materials
one small loaf of bread, unsliced
chocolate kisses (enough for each student)

Key Question
How does consumption and life style relate to waste generation?

Overview
This is a simulation where one student (representing the population of United States) receives one fifth of a loaf of bread (the world's food supply) and one fourth of a bag of candy kisses (the world's resources); the rest of the class (the rest of the world) must divide the rest of the bread and candy among themselves. The activity shows the unequal distribution of resources around the world. Students draw conclusions about unequal waste production as well.

Objectives
Students will understand that resources are unequally distributed around the world and that levels of consumption are related to waste generation.

Background Information
People in the United States account for 5% of the world's population, consume 25% of the world's resources, and control 20% of the world's food supply. The U.S. leads the developed world in consumption and production and far exceeds that of the emerging world.

The affluent lifestyles of many Americans lead to the production of far more waste per capita than most other countries in the world. The following chart compares waste generation in cities around the world.

Waste Generation Worldwide
pounds per person per day (ppd)

City	*Country*	*Daily Waste Generation*
Chicago	USA	5.00
New York	USA	3.97
Tokyo	Japan	3.04
Hong Kong		1.87
Hamburg	Germany	1.87
Medellin	Colombia	1.19
Calcutta	India	1.12
Kano	Nigeria	1.01

from *Waste Age*, Oct. 1989

Although Americans consume a disproportionate amount of the world's resources, there are many factors to consider in evaluating U.S. affluence: technology, manufacturing capabilities, food and aid supplied to other countries, humanitarian services, and democracy.

Management Suggestions

1. Plan this activity for a time that won't interfere with lunch appetites.
2. Allow for chaos when the world's resources are distributed.
3. If possible, have students wait until the results of the distribution are shared with the whole class before eating the resources.
4. Have additional candy on hand to help ease the feelings of inequity after the discussion is completed.

Procedure

1. Have students calculate 5% of the class and choose a student (if there are twenty or fewer students) or students to represent that 5%. Explain that the one or two students represent the population of the United States, and the others represent the population of the rest of the world.
2. With the help of the students, divide the bread into fifths and the candy kisses into fourths.
3. Explain that the bread represents the world's food supply and the candy kisses represent the world's resources.
4. Give 1/5 of the loaf of bread and 1/4 of the candy to the U.S. group.
5. Toss the remaining bread and candy into the center of the "rest of the world" group and allow them to divide as they see fit.
6. After the group settles down, discuss the results. At a certain point, bring the bread and candy *wrappers* into the discussion.

Discussion Questions

1. What were some of the feelings in the "rest of the world" group and in the U.S. group as they divided their portions among themselves?
2. Was the distribution fair?
3. Why do Americans consume as much as they do? Is this necessary?
4. Is there a relationship between wealth and waste?
5. How does the rest of the world benefit from the use of resources in the U.S.? What role does the U.S. play to improve the lives of others around the world?
6. What would happen if we brought in another 25 people to share the bread and candy? How does overpopulation in the "rest of the world" affect the distribution of resources?
7. What are some of the other causes of the inequitable distribution? Should we expect that the distribution of resources will change over time? What may be the cause of such changes? Should people take action to bring about such changes? What actions might be taken? What would be the costs and benefits of such actions?

Related Pathways

1. This activity stimulates virtually unlimited pathways. It would enrich units on economic systems, developing nations, or differing lifestyles. Look around for opportunities here to work with teachers in other disciplines and members of the local business and non-profit community.

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Awareness

Getting to the Route of the Hazardous Waste Problem

Level
■ *Intermediate*
◆ *Advanced*

Materials
diagram of a neighborhood (large chart or student handout)
map of region showing water resources

Key Question
What's wrong with throwing used oil down the drain?

Overview
Using a diagram of a hypothetical neighborhood, and a map of their own town/region students trace the route hazardous materials would take if they were thrown out in the trash or dumped down the drain. They discuss the dangers of hazardous products, proper disposal, and methods of avoiding their use.

Objectives
Students will describe how their homes are connected to the environment and how disposing of hazardous wastes improperly can harm the environment.

Background Information
Many household products contain ingredients which can be hazardous to people or the environment. These ingredients can be poisonous, flammable, corrosive and/or cause violent chemical reactions. Hazardous products generally fall into five categories: automotive products, cleaning and polishing materials, paint and related solvents, pesticides, and miscellaneous items (batteries, some cosmetics, shoe polish.) Unwanted portions of these products become household hazardous waste.

When hazardous wastes are disposed of improperly, they can contaminate septic systems, groundwater, landfills and incinerators. Waste oil, paint, and batteries are among the worst offenders (see **Background Information: Household Hazardous Waste.**) Products that are hazardous to discard are also usually hazardous to use. Reducing our reliance on these materials can improve our health as well as the health of the environment.

As with the management of all waste, the primary goal is to reduce the amount of waste that enters the waste stream, and then to provide for secure disposal. To do this, we all must be aware of which products we use at home and reduce our reliance on those that contain hazardous substances. We also need to dispose of the wastes responsibly.

The products most likely to contain hazardous materials include (but are not limited to):

Cleansers
(the most hazardous examples)
- *furniture polish*
- *oven cleaner*
- *drain opener*
- *spot removers*
- *toilet bowl cleaner*

Car Products
- *motor oil*
- *antifreeze*
- *car batteries*

Pesticides
- *flea powder/collar*
- *insect repellent*
- *weed killer*
- *garden insect spray*

Paint and Paint-Related Products
- *paint*
- *wood preservative*
- *wood stain*
- *paint brush cleaner*

Other Household Products
- *ni-cad (nickel-cadmium) batteries*
- *small, sealed lead-acid batteries (as used in emergency lighting)*
- *shoe polish*
- *fingernail polish and remover*
- *rubber cement*

Management Suggestions

1. Draw a schematic diagram of a neighborhood including houses, a septic field, storm drain on the street, trash cans by the house, car in the driveway, garden, and a transfer station off to the side. Either make a large diagram that can later be put on the bulletin board, or make hand-outs for students.
2. Use topographical maps of your area, town planning maps, or copy the map of your region from a commercial atlas for students to use to trace water courses and pollution sources.
3. This is a good oppotunity to get the local public works director or a technician from the local wastewater treatment facility into your classroom. Ask your guest to describe the path hazardous waste takes from homes and businesses in the community. The local Soil and Water Conservation District or State Department of Environmental Projection would also be able to discuss what happens to hazardous waste when it goes into groundwater and lakes and river. A health professional or chemist might come by to help students understand the "hazards" of hazardous materials. It may be difficult to get the most out of this activity without community assistance.

Procedure

1. Write the categories of hazardous products on the board and help students list (brainstorm) what types of products in their homes contain hazardous materials. Be sure students have some understanding of why the materials are hazardous.
2. In small groups, have students predict what could happen if household hazardous wastes were:
   - thrown out with the trash
   - poured down the drain
   - dumped on the ground
3. On the diagram of a neighborhood have students trace the routes wastes would take if they were thrown out, poured down the drain or dumped on the ground. Draw the routes in different colors.
4. Using a map of the community or area, have students highlight all the water sources close to their homes and school and trace connected sources of water. Highlight any landfills or other possible sources of pollution and water sources that could be affected.
5. Discuss proper methods for the disposal of these products. Emphasize regional collection sites, household hazardous waste collection days, completely using products, and choosing alternative products.
6. Have students write a group paragraph to answer the question, "Knowing what you do about hazardous products, do you think it is important to treat them differently than non-hazardous waste when you throw them out?"

Discussion Questions

1. How can you keep hazardous wastes from polluting your neighborhood?
2. How could it be easier for your family to properly dispose of household hazardous wastes?
3. What hazardous materials are used in the school?
4. What can be done to reduce the amount of household hazardous wastes produced? What can you do?

Related Pathways

1. This activity is nicely enriched by *interage cooperation:* high school biology or chemistry students might explain the effects of poisons to intermediate students, or better still, devise a dramatic demonstration of a hazard.
2. Consider ***assessment pathways*** **Home Hazardous Waste Audit** (on this path students work with their parents to list hazardous materials in the home) and **School Hazardous Waste Audit**. Later, consider one or more of the ***action pathways*** devoted to hazardous waste (**Promoting Alternatives. . ., Waste Paint. . . , Battery Use. . .**).

Awareness

Everyday Choices for a Sustainable Future

Level

■ Intermediate

◆ Advanced

Materials

Gather the materials, and share them with other teachers in your area.

- **white paper:**

a stack of paper blank on one side

notepads made from that paper

crumpled paper from wastebasket

- **lunch wrappings: paper lunch bag**

plastic baggies

throw-away milk carton

aluminum foil

fabric bag

plastic-covered sandwich holder

plastic-covered dish

washable drink-bottle

- **shopping bags: paper bag**

plastic bag

fabric bag

- **container of concentrated detergent, regular strength**

- **beverage containers: fast-food cold cup**

small milk carton

aluminum can

(continued next page)

Key Question

How do you know which are the best products to buy when you go shopping?

Overview

This is a comprehensive look at things we do and common products we buy which can either help protect the environment or make waste and pollution problems even worse. In either a game format for two teams and a panel of judges, or in a discussion format, students compare small groups of familiar products and decide which choices would be better for the environment. As each group of items is presented students offer information and opinions and an "expert" adds information about waste production, energy consumption, recycling, and pollution prevention.

Objectives

Students will compare products, decide on the ones that best help to reduce waste and prevent pollution, and relate each item to the waste management hierarchy. Students will evaluate their own behaviors and purchasing decisions.

Background Information

Consumers face a bewildering array of products in the marketplace. How do you decide what to buy? The average consumer considers cost and convenience. Environmentally responsible consumers also consider waste, pollution, and impact on the environment. To look toward a sustainable future, we all must become environmentally responsible citizens and think of how our actions and decisions affect the environment.

The ultimate Pathway to a Sustainable Future is one where we reduce waste, which prevents pollution and protects the earth's natural resources. This pathway follows the Waste Management Hierarchy (WMH) endorsed by the U.S. EPA. The WMH sets the priorities for managing waste. It calls for:

1. Source Reduction
2. Reuse
3. Recycling
4. Composting
5. Incineration and Waste-to-Energy
6. Land Disposal

Source reduction is the highest priority of the WMH. By emphasizing reduction and reuse we can move closer to a sustainable future by preventing pollution and protecting natural resources. By taking recyclables to a collection center, and buying products made from recycled materials we are "closing the loop" to further reduce waste. In making choices about products we buy and things we do, we should aim to be as high on the hierarchy as we can!

More information about the activity materials is included in the section Additional Information for the "Expert."

Management Suggestions

1. Gather the items ahead of time, using as many as possible from around the school or from students. Substitute items if necessary.
2. Decide which of the two activity formats to use with the class.

   Discussion Format: Small groups of students analyze the products in each step and help with discussion. For each step of the activity choose an appropriate number of students to analyze the items. Have them do the task and answer the questions. The whole class should be encouraged to participate with the volunteers in the discussion. Have the class answer the question about the Waste Management Hierarchy.

   Game Format: Select a panel of judges and divide the class into two teams. Two players (one from each team) accomplish the *task* cooperatively, then each answers a *question*. The judges may ask the teams to clarify their answers. They award up to ten points to each team for their answer. The teacher (or another "expert" using the notes at the end of this activity) may offer additional information. After the points are awarded, the class should answer the question about the Waste Management Hierarchy.
3. Keep the information at the students' level of understanding. The groups of items begin with easier, more obvious choices and comparisons, then get more difficult. Steps can be eliminated or modified if they are beyond the level of the students.

◆ **Advanced Level Activity:** Steps describing additional hazardous materials are included in the section on "Information for the Expert". If you want to focus on hazardous materials, begin the activity with batteries and continue with glue, furniture polishes, oven cleaners, drain openers, paint, and mothballs.

Procedure

1. List the waste management hierarchy on the board (refer to the WMH during each step.)
2. If you are using the game format, choose judges and divide the teams. Explain the process of performing the task, answering the questions, and awarding points. Begin with the first step.
3. If you are using the discussion format, ask for the first volunteers and have them perform the task for the first step. Have the volunteers answer the questions. Have the class discuss their answers.
4. Continue moving through the steps, encouraging discussion and having students relate choices to the WMH.
5. Conclude the lesson by discussing which of the choices seem to be the most important for protecting the environment. What will you do (or ask your parents to do) differently when you go shopping?

Presentation Steps

1. "Waste" Paper: Describe possible uses for two reusable forms of paper.
   Task: Line up three items in order of reusability - a piece of crumpled paper from the wastebasket, used paper blank on one side, notepads made from that paper.
   Question 1: What are three good ways to use paper that is blank on one side, rather than throwing it away?
   Question 2: Why is reusing the paper better than recycling it? When should it be recycled?
   (How does each way of dealing with used paper fit on the WMH and help provide for a sustainable future?)

2. Lunch Wrappings: Compare throw-away items versus reusable lunch containers.
   Task: Separate the wrappings into two groups: Reusable and disposable.
   Question 1: How could each of the disposable items be reused?
   Question 2: Which is the better way to pack a lunch? Why?
   (How does each type of lunch fit on the WMH and which helps provide for a sustainable future?)

Materials (cont.)

glass bottle (refillable)

iced tea concentrate jar

empty glass

• batteries:
disposable (AA, C, or D size with no added cadmium or mercury)

button battery

rechargeable batteries

solar rechargeable batteries

toy not requiring a battery (e.g. Slinky™)

• glue:
white glue (Elmer's Glue-All™)

rubber cement

optional: Hazardous materials (hazmats) two brands of each:
• furniture polish: petroleum based, lemon oil polish

• oven cleaners: corrosive type, fume-free oven cleaner

• drain opener: any two brands

• paint: oil-based paint and latex paint

• moth balls

• alternative products spray bottle

vinegar

baking soda

Murphy's Oil Soap™

Everyday Choices for a Sustainable Future

3. Shopping Bags: Compare paper, plastic, and fabric bags.
   Task: Line up the three bags from the "best" to the "worst."
   Question 1: What does the bagger ask you at the check-out line at your grocery store? How do you usually answer? Why?
   Question 2: Which type of bag is the best for the environment? Why?
   (How does each bag fit on the WMH and which helps most to provide for a sustainable future?)

4. Beverages containers: Compare fast-food cold cup, small milk carton, aluminum can, refillable glass bottle, jar from iced tea concentrate, empty glass.
   Task: Arrange items in order from the largest amount of waste produced to the one generating the least waste.
   Question 1: Why did you arrange the items this way?
   Question 2: Is it better to recycle or refill the glass bottle? Why?
   (How does each container fit on the WMH and which help the most to provide for a sustainable future?)

5. Detergent: Compare regular and concentrated detergents.
   Task: Decide which detergent is less harmful to the environment.
   Question 1: How does the concentrated detergent reduce waste?
   Question 2: How might the concentrated detergent be more harmful or dangerous?
   (Where does each detergent fit on the WMH and which helps more to provide for a sustainable future?)

6. Batteries: Compare disposable, button, rechargeable, and solar rechargeable batteries. Look at a non-electric toy and discuss the alternatives to dependence on battery powered toys.
   Task: Arrange the items according to the amount of waste they produce *and* the amount of energy used.
   Question 1: How are disposable batteries harmful to the environment?
   Question 2: How would your life be different if you used no disposable batteries? No batteries at all?
   (Where does each product fit on the WMH and which help the most to provide for a sustainable future?)

7. Glue: Compare rubber cement and Elmer's Glue-All™.
   Task: Decide which type of glue is least harmful to people and to the environment.
   Question 1: Which glue is better to use? Why?
   Question 2: What are the dangers in rubber cement? What are the signal words on the label?
   (Where does each type of glue fit on the WMH and which helps more to provide for a sustainable future?)

8. Optional demonstrations can look at Furniture Polish, Oven Cleaners, Drain Openers, Paint, Mothballs, and Looking at Labels.
   See discussion in Additional Information for the "Expert" below

Additional Information for the "Expert"

Waste Paper

Paper used on one side can be discarded, recycled, or reused.

By using the other side of the paper less waste is produced in the first place even before thinking about recycling.

Notepads are made by cutting up the paper, applying glue at one end and then allowing it to dry.

Lunch Wrappings

The paper bag does not have to be discarded, it *could* be reused even if it usually is not.

It takes soap and water to wash the plastic items and some day the plastic items will be thrown away.

The fabric bag may need to be washed from time to time. (The choice is not all one-sided.)

Shopping Bags

Brown paper bags can be recycled (usually processed and recycled with cardboard.) They can also be reused. If treated carefully, they can be reused many times.

Some people use the paper bags to package other recyclables.

Plastic bags can also be reused or recycled as well as thrown out, but the functional "life" of a plastic bag is shorter.

Fabric bags cost money to buy or make, are not waterproof, and need to be washed. They are much more durable.

Beverage Containers

Fast-food cold-drink cup is paper coated with plastic. It is a single-use item.

Milk carton is paper coated with plastic. Although the carton usually is discarded, it *could* be recycled.

Recycling aluminum creates less waste than manufacturing aluminum from raw materials. It takes 90% less energy to recycle aluminum than to mine bauxite and manufacture new cans.

A little-known point: the colorful printing on the can must be removed before the can is recycled; to do this, the cans must be processed at high temperatures — this, of course, uses energy.

Recycling glass containers takes less energy than manufacturing new ones. Saving raw materials is not as important as it is with aluminum (the silicon and oxygen oxides used to make glass are *very* abundant in the earth's crust.)

It takes less energy to refill a bottle than to make new glass bottles. Refilling glass bottles is feasible for *local* markets — if you have to transport the heavy glass bottles very far, more energy is used in transporting them than is saved by refilling them. Today, most bottling concerns are located far from markets.

Beverage concentrates require less packaging — so they create less packaging waste — and so they use fewer resources; they also use less energy per serving for transportation.

It takes energy to *dry* the beverage powder, so we cannot say — without more information — that using a concentrate is necessarily better for the environment as a whole. *Frozen* concentrate is probably not better for the environment. Because of the energy used in refrigeration, it is doubtful that frozen concentrated beverages represent a move toward pollution prevention.

The average American drinks more beverages in containers than water from the tap.

Detergents

Americans represent only 6% of the world's population, but they use 25% of the world's industrial raw materials. Detergents (laundry detergents, dish washing detergents, shampoo) are one example of how we overconsume: Americans use half of the world's supply of detergent.

More of the material in a box of concentrated detergent is "detergent" and less is "filler."

The down-side to concentrating a detergent: Detergents are the most common source of poisoning in young children. If the detergent is more toxic than the filler used, a child ingesting the concentrated detergent may receive a higher dose of the more toxic substance.

Batteries

Americans throw away 2.7 billion batteries a year.

It takes about fifty times as much energy to produce the battery as the battery itself produces when you use it — a 2% efficiency in energy use. Compare this to the energy efficiency of an internal combustion engine (about 20%), or the efficiency of an electric power plant (about 40%).

Throwaway batteries are also sometimes a source of heavy metals in landfills (and groundwater) or incinerators (in the ash or in smoke.) Mercury, cadmium and lead are examples of heavy metals. Heavy metals are toxic (sometimes in very low doses) to plants, animals and humans exposed to them. It is now against the law for manufacturers to add mercury to batteries.

It is not profitable to recycle these batteries today, so they are thrown away. In addition to wasting energy, we waste the resources used to produce these batteries. (However, there is an international effort to

look for ways to make battery recycling profitable.)

The label on some disposable batteries says *Safer for the environment* because no mercury or cadmium have been added when manufacturing them. This is helpful, but the batteries still waste energy and resources.

Rechargeable batteries use fewer resources because they can be used many times. Using them is better for the environment. It takes electrical energy to recharge them, but much less energy than it takes to manufacture new ones.

Solar rechargeable batteries are really much better for the environment because the sun's energy is used to recharge the batteries and they can be reused many times. Unfortunately, they may take many hours of sunlight to recharge — we expect that there will be future improvements in solar batteries.

Non-electric toys reduce waste and protect the environment by avoiding batteries in the first place (source reduction.)

Reducing Use of Toxics

One way of practicing pollution prevention is to lower our exposure to toxic substances.

White glue and rubber cement

The label on rubber cement says "danger, extremely flammable."

The glue-all label says "safe, no harmful fumes."

For some uses, the white glue works as well as rubber cement — when this is true, which product would you use?

Flammable usually indicates a material that catches fire more easily than a combustible one, but both need to be treated with care.

Using the Glue-All™ is a type of pollution prevention called *toxics use reduction* — you are lowering your exposure to a toxic substance.

Furniture polish

The label on a petroleum-based brand says "danger, extremely flammable."

The lemon oil polish is "non-toxic, non-combustible."

A third, and inexpensive, choice is home-made polish. Mix vegetable oil with a little lemon juice — this is cheap and non-toxic.

Oven cleaners

The label on the corrosive oven cleaner reads, "Danger: may cause burns to skin and eyes, contents under pressure. Harmful if swallowed. Read cautionary labeling on back panel."

The other oven cleaner reads, "Fume free, non-caustic formula cleans without lye."

How else might you take care of your oven that could avoid the use of either product?

What can you do to keep your oven from having to be cleaned as often?

Drain openers

The label on one can of drain opener may read, "DANGER: keep out of reach of children. Can cause burns on contact. Harmful if swallowed. Read back label carefully."

Another can may say, "Poison, Harmful or fatal if swallowed or misused. Causes severe burns to eyes and skin on contact. Keep out of reach of children. Read precautions on back panels carefully."

Do *either* of these *caustic corrosive* products sound safe to use? Are there other ways to keep drains clean?

Use preventive maintenance. For example, your parent can carefully pour boiling water down the drain once a week, sometimes with baking soda. If the drain becomes stopped up anyway, try using a plunger to open it up. Or, if you have a mechanical snake, use it.)

In the U.S., drain openers are responsible for more than 2,000 visits per year to hospital emergency rooms.

Paint

Discuss the differences between oil-based paint and water-based (latex) paint. The oil-based paint leads to more indoor air pollution than with the water-based paint; it is more flammable, and usually it is more toxic.

Moth balls

Why are moth balls used?

What problems could there be with the use of moth balls? (e.g. indoor air pollution, a small child swallowing the moth balls).

Moths are attracted to stains on a fabric — fabrics put away clean do not attract moths.

Ask students to mention other products around the home that may be of concern and discuss these.

Looking at Labels

Signal words: Look for the word *poison* or *danger* on the label. *Danger* and *poison* are signal words indicating an especially toxic or otherwise dangerous substance.

For *pesticides*, the signal word *warning* refers to intermediate toxicity and *caution* to the lowest toxicity.

For *chemical products* other than pesticides, *warning* or *caution* do not have as precise a meaning as for pesticides, although *caution* usually refers to a lower degree of hazard.

The word *caution* really does indicate a *need* for caution. Many accidents occur with products with a simple caution on the label. For example, detergents are a very common cause of poisoning in small children.

"Non-toxic" has no legal meaning — any substance can be toxic in high enough doses. However, if a product ingredient meets the legal definition of hazard, it must have a signal word on the label, so 'non-toxic' may be assumed at least to be *less* toxic.

Signal words refer to the *acute* toxicity of the substance — an adverse health effect that occurs soon after exposure. Signal words may not be useful when thinking about long-term exposure to a substance — *chronic* toxicity. This is another reason to use *all* products with care.

Discussion Questions

1. Who is responsible for producing waste?
   Discussion
   We are all responsible — industry and other businesses, our towns, *and you and I.* Our consumption habits lead industry to produce ever larger quantities of consumer products which leads to:
   - Depletion of resources;
   - Pollution as these products are produced;
   - Pollution as they are used, recycled, or thrown away to landfill or incinerator.
2. Why is it important to stay near the top of the Waste Management Hierarchy?
   Discussion
   The higher we stay, the less waste and pollution we will produce. Source reduction is also called Pollution Prevention (P2). Examples are
   - Increased efficiency in using raw materials, energy, water and other resources — conservation;
   - Using fewer hazardous substances;
   - Purchasing fewer consumer goods or consumer goods with less packaging.
3. Why is it better to reduce and reuse than it is to recycle?
4. What habits do you think you (or your family) will be able to change when you shop?
5. How can you help other people understand why it is important to make different decisions?

Adapted and rewritten from the activity "Moving Toward Pollution Prevention" developed by Dr. Marquita Hill, and funded by a grant from the U.S. EPA to the Chemicals in the Environment Information Center at the University of Maine, 105 Jenness Hall, Orono, Maine 04469; (207) 581-2301.

Awareness

For Better or Worse

Level

■ *Intermediate*

◆ *Advanced*

Materials

boxes or packages from home that demonstrate both wasteful and low-impact packaging

- ***multi-layered, difficult-to-recycle packaging***
- ***single serving items***
- ***"natural" packages (apple, peanuts)***
- ***concentrated products and lightweighted packaging (laundry detergent)***
- ***packaging from renewable resources (paper)***
- ***packaging from recyclable resources (glass bottle, aluminum can, steel can)***
- ***similar products in "better" and "worse" packaging.***
- ***recycled content packaging***

Key Question

How can I make good decisions about packaging I buy in the store?

Overview

Given a variety of empty packages, students arrange them in order from "better" to "worse" considering the environmental impact of the packaging material. A small group discusses the items to reach consensus about the sequence. In the process they learn about the qualities of efficient, low-impact packaging as well as how to recognize excessive, wasteful packaging. They also evaluate their family's and their own purchasing decisions. Students can provide materials by bringing a variety of clean, empty packaging from home.

Objectives

Students will compare the packages of consumer items; they will evaluate the environmental impact of packaging and propose actions they can take to reduce excess packaging.

Background Information

Packaging serves many functions: to provide protection of a product from damage, to preserve freshness, to provide security from tampering, to prevent theft, to help advertise and for consumer convenience. Packaging and advertising certainly influence what people buy. Although we have many options in the marketplace, many of us pay extra for convenience that we don't really need. Efforts are being made by many manufacturers to provide packaging that is less wasteful, both in terms of the energy and natural resources used in manufacturing and in the contribution to the waste stream. One way to reduce the amount of waste we generate is by making thoughtful choices when we buy packaged products. Look for the manufacturer's environmental statement on the label. Be objective, however, about the information provided and evaluate the information. Gray-colored paperboard (the type used in many cereal boxes) is usually made from recycled paper.

Packaging is one of the many things we think about when deciding to buy a particular product. There are many different perspectives when you consider packaging: How safe is it? How strong is it? How expensive is it? How well does it serve its purpose? Another important perspective asks, How environmentally sound is it? The goal of this activity is to have students look at packaging from the perspective of its environmental impact.

Packaging can be evaluated for environmental impact by considering:

- How renewable are the resources the packaging is made from?
- How easy is it to recycle the packaging?
- Is the packaging made with recycled materials?
- Is the packaging made from multiple layers (paper, plastic, metal, etc.) which are particularly difficult to recycle?

- Has the packaging been designed to use less material ("lightweighted")?
- Does it contain a concentrated product so less packaging is needed per unit of product?
- Does it contain a hazardous product which might contaminate the package and make it difficult to dispose of the package safely?
- Does it contain small individually wrapped units?
- Could it be sold in bulk, eliminating the need for manufactured packaging?

Management Suggestions

1. The first part of the activity helps prepare students with information about the environmental impact of different types of packaging.
2. The second part gives students the opportunity to use this information to evaluate a large group of packages and make decisions.
3. Encourage students to be objective about their items. They should discuss how the items compare, and they should discuss the aspects of their items and agree where they fit in the line. If there are arguments the teacher can use the opportunity to help look objectively and resolve the differences with help of the group.
4. *Students should consider the packaging **only**, not the contents.* This is difficult, but if they think of the contents of all the packages as the same product, for example, raisins, it is easier to make consistent judgments.

Procedure

Part 1

1. Place four items on a table in front of the class. Make the selection as diverse as possible. Have two students arrange the items from environmentally "best" to "worst" on the basis of packaging. Have the students line the items up, discussing among themselves as they go along.
2. Discuss their decisions using the categories listed in the Background Information.

Part 2

3. Have each student choose an item as "their own."
4. Students then must decide if their item is "better" or "worse" than the others and get into their place in line. Students should discuss *and agree* that each person is in the best place in the line.
5. When the line is settled, have each student give one observation about the package that helped her or him decide this was the best spot in line.

Discussion Questions

1. What was environmentally "better" about some items and "worse" about others?
2. In choosing products and packaging, do all people have the same likes and dislikes; the same needs?
3. How could some of the "worse" items be redesigned to be made "better"?
4. When would you choose not to buy a product because of the packaging?
5. What other things could we consider when choosing "good" and "bad" packaging?
6. What steps can you take to encourage manufacturers to limit excess packaging or inform consumers not to buy products with excessive packaging?

Related Pathways

1. Advanced students might go on to judge the packaging "better or worse" according to other criteria (cost, safety, appropriateness, strength, attractiveness), and then according to several criteria at once (environmental impact, cost, and appropriateness). How should the criteria be "weighted?"

Adapted from an activity (adapted from CONEG) by Gayle Briggs, planner for the Maine Waste Management Agency Office of Waste Reduction and Recycling.

Awareness

Are Ten Better Than One?

Level
● Beginning
■ Intermediate

Materials
unopened boxes of cereal: 1 variety pack of individual boxes 1 large box

containers to store the cereal

measuring cups to measure the volume of cereal

tape

measuring stick

chart paper to record measurements

Key Question
How does the size of a package affect how much packaging is used and how much waste is produced?

Overview
Students disassemble the packaging from both a 10-pack of individual cereal boxes and a single large size cereal box. They tape the inner and outer layers together so they can measure the area of material each package contains. They can easily compare the inefficiency of single serving packages to the efficient larger size.

Objectives
Students will compare the amount of packaging required for single serving boxes with packaging from a single larger box. They will relate this to the amount of waste generated and their own role in reducing waste.

Background Information
Packaging is used to keep food products fresh and to help sell the product by appealing to the consumer. "Convenience foods" are designed to make shopping and preparation easier for consumers. The cost of packaging is a large part of the cost of many food items. Research shows that one dollar out of $11 spent on food pays for packaging. In addition, most packaging must be discarded or recycled when the product is used up. In smaller sizes the percentage of packaging is larger.

Consumers decide to buy any particular product for many individual reasons. As students become aware of the inefficiency, expense, and disposal problems associated with individual packaging, they (and their families) can make more informed choices in the marketplace.

Management Suggestions
1. Keep the cereal product clean so it can be eaten after the lesson is completed.
2. Students may work in teams to prepare the packaging and make measurements. The help of two or three parents will allow many more students to participate at once.
3. At the end of this activity, display the completed package strips, chart paper, and calculations on a bulletin board.

Procedure

1. Look at the two unopened cereal packages and have students estimate the number of servings in each. Define net weight and compare weights on the packages. Have a student read the number of servings per package on the label and compare to the estimates made.
2. Ask students which package they think has more packaging.
3. Carefully remove the outer wrap from the variety pack, open up and flatten the cellophane to demonstrate how the rest of the packaging will be opened up.
4. Pass out the boxes of cereal to students. Have them open the boxes and put cereal into the proper container.
5. Have the students separate the inner lining from the box and flatten the materials.
6. Help the students tape the various components of each package together into one strip for the variety pack, and another strip for the large box. Try to arrange the pieces so they have similar width.
7. Hold the two strips up to compare the length of each with the volume of cereal that each package held.
8. Data and Analysis

   ● **Beginning:** Measure the length and width of each strip.

   ■ **Intermediate:** Calculate the surface area of packaging in each package. Calculate the amount of packaging per unit of product; cost of the packaging per unit.

Discussion Questions

1. Which of the packages had more cereal? Which had more packaging?
2. Why do smaller packages have more packaging material per serving?
3. How is the packaging disposed of when the cereal is gone? What is the effect of individual packaging on the waste stream?
4. What other products come in individual packages?
5. Why do people buy things in small packages? When might it be necessary? When might it be unnecessary? When might buying larger packages result in more waste than buying small packages?
6. How can the amount of waste from packaging be reduced?
7. What can you do to help reduce the waste stream?

Awareness

Paper, Plastic, or Cloth?

Level

■ Intermediate

Materials

samples of each type of shopping bag: paper, plastic, cloth

three "bag type" cards for each group of players

one set of cards for each group of players (cut apart the cards provided and reuse paperboard for a backing)

score paper

Key Question

When we go shopping what kind of bag is best?

Overview

This activity is a card game in which each player represents a type of shopping bag: paper, plastic, or cloth. Each card has a statement about a characteristic of the different bags and point value, either positive or negative. If the statement applies to the bag the player represents, the points are added (or subtracted) to the total score. Although the cloth bag is favored to win, this is not guaranteed. Students discover the trade-offs between the different bag choices and that environmental choices are rarely black and white.

Objectives

Students will compare the benefits and liabilities of paper, plastic, and reusable cloth grocery bags; they will judge environmental decisions and recognize that they are rarely clearly right or wrong.

Background Information

At the supermarket checkout counter, the clerk usually asks if we want a paper or plastic bag. Most environmentally concerned shoppers ask for a paper bag because they know paper is made from trees, a renewable resource. Plastic is not biodegradable and is made from nonrenewable oil.

But this is not such a simple issue! Brown paper bags are made mostly from new pulp (on average, paper bags contain only 6% recycled fiber.) Trees are often grown in heavily fertilized plantations or clear cut from wild forests. The paper-making process adds to water pollution and acid rain. Paper and plastic bags both are usually landfilled or incinerated. Plastic shopping bags are usually made from non-renewable low density polyethylene (LDPE - #4) which actually may be less damaging than paper is to the environment because they use much less raw material in manufacture, are lighter, and take less space in landfills. Cloth shopping bags have obvious advantages because they are reusable, washable, and are made from renewable resources, but they also have disadvantages in that they are more expensive to buy, are not waterproof and are less convenient.

The Game

Paper, Plastic, or Cloth? is a card game for three players, or three teams of two or more. Each player or team represents a paper bag, plastic bag, or reusable cloth bag. The game begins by choosing a "bag type" card to determine which bag each player or team represents. Playing cards are dealt face down.

For each round, players flip the cards up simultaneously as in the game of Slap Jack. If the point values of any two cards are the same, the player who slaps the opponent's card that matches his or her own point value claims both cards.

Players then read the statements on the cards. If the statement applies to the player's "bag type," the points are added to or subtracted from the team score. Discussion can help resolve differences of opinion and the chart below might help mediate.

The game continues until one team reaches 50 points or all the cards are played. Following the law of averages, the cloth bag should win this game, yet any of the bags could win, depending on skill and luck. Students will conclude that there are trade-offs for each type of bag.

Card Topics

Characteristic	# cards	Points	Paper	Plastic	Cloth
Made from trees - mostly new pulp	1	-5	x		
Made from unbleached paper pulp	1	+5	x		
Paper-making produces water pollution	1	-10	x		
Paper-making adds to acid rain	1	-10	x		
Made from a renewable resource	3	+10	x		x
Biodegradable	2	+15	x		x
Burns relatively clean when incinerated (when burned, both unbleached paper and polyethylene produce fewer emissions than bleached paper)	2	+5	x	x	
Easily recycled with cardboard	1	+5	x		
Not waterproof	2	-5	x		x
Double bags often needed for strength	1	-5	x		
Can be reused more than once	3	+5	x	x	x
Can be used for more than a grocery bag	3	+5	x	x	x
Paper bags rip if filled too full	1	-5	x		
Not biodegradable	2	-10		x	
Made from non-renewable resources	1	-10		x	
Plastic bags dyed red and yellow can contain heavy metals which can pollute	1	-10		x	
Can be hazardous to ocean animals	1	-10		x	
The bag most difficult to recycle	1	-5		x	
Can contain vapors which can get into food and be harmful	1	-5		x	
Convenient - don't need to take it with you to the store	2	+5	x	x	
Waterproof	1	+5		x	
Often has handles and is easy to carry	2	+5		x	x
Can get holes easily which makes it unusable for many trips	2	-5	x	x	
Can be reused hundreds of times	2	+20			x
Lightweight	3	+5	x	x	x
Less convenient - you have to take it with you to the store	1	-5			x
Most expensive - you have to buy it or make it	1	-5			x
Can be washed and reused	1	+5		x	x
Strongest type of bag	1	+10			x

Preparation

1. Prepare a set of playing cards for each group. Cut out the statements and glue them on card-sized tag board for durability. Mark the "bag type" cards so they are kept separate from the playing cards.
2. Review the concepts on the cards so students are familiar with the words and facts.
3. If this game is played in teams, have one individual from each team play a round. Rotate team members after each round.

Rules for playing the game

1. Each team (or player) chooses one of the "bag type" cards to determine which type of bag the team represents.
2. Deal all the cards out to the three teams, face down. Each team (or player) should have an equal number of cards.
3. On a signal (the players can count out 1-2-3-go) the three players flip their cards simultaneously.
4. If two players turn up cards with matching point values, the player who slaps the opponent's matching card before having his or her card slapped, claims both cards as his or her own. (Players should be careful of slapping cards with negative point values!)
5. The player with the highest point value begins the game.
6. The player reads the card aloud and says whether the statement on the card applies to the team's "bag type." If the statement applies, the points are awarded to the team (either positive or negative.) If the statement does not apply, no points are awarded. (e.g. If the "paper bag" team has a card that says "Biodegradable," they are awarded the

Paper, Plastic, or Cloth?

15 points assigned to the card; if the "plastic bag" team gets "Biodegradable," they receive no points for that card.)

7. The other two players read their cards and record their score to complete the round.
8. Repeat the procedure for the next round, keeping track of the score. If teams are used, rotate players for each round.
9. The winner is the first team (or player)to reach 50 points or the team with the most points when all the cards have been read.

Discussion Questions

1. Which bag won? Is it the best to use?
2. Are there times when one bag is better than another?
3. Why isn't it a clear choice?
4. Which cards were the most important in the game? Why?
5. Are there cards that you think have too high a value? Too low? If you had to change the value assigned to one of those cards, which one would it be?
6. Some supermarkets claim that their plastic bags are fully made from recycled plastic, and that they will be fully recycled again if returned to the store. It is also said that very high quantities of pesticides and herbicides are used in growing the cotton used in most fabric bags. Check out these claims. Are they strong enough to affect the game?
7. What advice should you give your family about bags when you go shopping?

Related Pathways

1. For intermediate groups that have traveled the last four ***pathways***, a trip to the supermarket may be in order! Plan precise activities for gathering information about toxic ingredients, packaging materials, package size, or grocery bags, and enlist enough parents so that most of the activities can be conducted in small groups. Contact the store manager in advance and explain your plans, trying to find a time when the store will not be too crowded, and the manager will be free to spend some time with the group. The store manager will be inclined to advocate the company's position on packaging issues, and so it would be a very good idea to be sure that at least one adult well versed in recycling issues (perhaps a member of the local recycling committee), is along to keep discussions healthy.

Score Sheet: Paper, Plastic, or Cloth?

Use one space to tally the scores in each round. Add or subtract the score.

Round	Paper Bag Team	Plastic Bag Team	Cloth Bag Team
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Bag Type **Paper Bag**	Bag Type **Reusable Cloth Bag**
Bag Type **Plastic Bag**	**-5** Made from trees - mostly new pulp
+5 Made from unbleached paper pulp	**+10** Made from a renewable resource
+10 Made from a renewable resource	**-10** Paper-making produces water pollution

+10 ***Made from a renewable resource***	**+15** ***Biodegradable***
-10 ***Paper-making adds to acid rain***	**+ 5** ***Can be reused more than once***
+ 15 ***Biodegradable***	**+ 5** ***Can be reused more than once***
+ 5 ***Burns relatively clean when incinerated when burned, both unbleached paper and polyethylene produce fewer emissions than bleached paper***	**+ 5** ***Burns relatively clean when incinerated when burned, both unbleached paper and polyethylene produce fewer emissions than bleached paper***

+ 5 ***Can be reused more than once***	**+ 5** ***Can be used for more than a grocery bag***
+ 5 ***Easily recycled with cardboard***	**+ 5** ***Can be used for more than a grocery bag***
- 5 ***Not waterproof***	**+ 5** ***Can be used for more than a grocery bag***
- 5 ***Not waterproof***	**- 5** ***Double bags often needed for strength***

- 5 **Paper bags rip if filled too full**	**- 10** **Not biodegradable**
+ 5 **Convenient - don't need to take it with you to the store**	**+ 5** **Convenient - don't need to take it with you to the store**
- 10 **Not biodegradable**	**-10** **Made from non-renewable resources**
+ 5 **Waterproof**	**+ 5** **Often has handles and is easy to carry**

- 10 Plastic bags dyed red and yellow can contain heavy metals which can pollute	**- 10** Can be hazardous to ocean animals
+ 5 Often has handles and is easy to carry	**- 5** Can get holes easily which makes it unusable for many trips
- 5 Difficult to recycle	**- 5** Can contain vapors which can get into food and be harmful
- 5 Can get holes easily which makes it unusable for many trips	**- 5** Less convenient - you have to take it with you to the store

+20 **Can be reused hundreds of times**	**+20** **Can be reused hundreds of times**
- 5 **Most expensive - you have to buy it or make it**	**+5** **Lightweight**
+ 5 **Can be washed and reused**	**+10** **Strongest type of bag**
+5 **Lightweight**	**+5** **Lightweight**

Where'd You Get That Can?

Key Question
Why is recycling aluminum more efficient than making aluminum cans from raw materials?

Level
■ *Intermediate*

Materials
2 large buckets

5 heavy bags (about 10 pounds of sand or a half cement block in each grain bag is ideal)

10 bricks

5 balls of crumpled newspaper covered with aluminum foil (about the size of a soccer ball)

10 wooden blocks covered with aluminum foil (8 inch sections of 2x4 are ideal)

50 aluminum cans (in 2 boxes of 25 cans each)

25 crushed cans in a box

signs identifying each station and each process

8 boxes

Overview
This is a relay race for two teams using a large space (like the area of a basketball court) either indoors or outdoors. One team follows the course of aluminum cans manufactured from bauxite ore and the other follows the course of recycled cans. The materials and distances in each course correspond to the real manufacturing processes. Students learn that it takes much more energy to make aluminum from raw materials than it does to recycle. Depending on how the course is set up, however, the times can be close; there is no guaranteed winner.

Objectives
Students will compare the energy (effort) it takes to produce goods from raw materials and from recycled materials; they will evaluate the importance of reducing and reusing before recycling.

Background Information
Aluminum is the third most common element on the earth's surface, yet processing aluminum from the earth into useful products is very difficult. Mining aluminum ore (bauxite) and refining the aluminum demands vast amounts of energy and is very polluting. High grade bauxite, which contains about 45% aluminum oxide, is blasted and dug from the earth, then transported to a processing plant. There it is crushed, washed, dried and transported to a refining plant. The powdered ore is dissolved chemically then dried again to produce alumina (a compound of aluminum and oxygen) and transported to a smelting plant. In the smelting process, alumina is melted, combined with carbon rods and charged with a powerful electric current (750 volts), which produces equal amounts of pure aluminum and carbon dioxide. The molten aluminum is then formed into ingots which can be molded into various products. It takes about 4 pounds of high grade bauxite ore to produce one pound of aluminum. One pound of aluminum makes 25-30 soft drink cans.

To recycle aluminum, used aluminum cans or aluminum scrap materials are collected, shredded, re-melted and formed into ingots which can be molded into various products. About 95% less energy (mostly electricity) is used to recycle aluminum than to produce aluminum from bauxite ore. In addition, recycling aluminum creates 95% less air pollution and 97% less water pollution. It takes 1.25 pounds of scrap aluminum to make one pound of reprocessed aluminum. It can take as little as six weeks from the time a can is purchased in the store until it is remanufactured and back on the store shelves. In 1991 62.4 % of aluminum beverage cans were recycled in the U.S. In 1997 the percentage was 66.5.

Awareness

Where'd You Get That Can?

Management Suggestions

1. This is a relay race which demonstrates the relative amounts of energy used in producing aluminum cans from raw materials and from recycling. Do this activity in the gym, hallway or outside; it is a noisy activity and requires a minimum course length of 60 feet.
2. The materials for this activity are bulky and some are heavy. Students can help gather the materials needed for the activity in the days before the race. Big and clear signs identifying **Mining** and **Recycling** processes, and smaller signs at each station, will be excellent tools for teaching and management.
3. Time each team and keep a record of each round.
4. Plan to award prizes to the winners.
5. When finished be sure all materials are reused or recycled!

Relay Race Description

1. Two teams run separate courses which symbolize
   - Mined Aluminum Manufacturing Process
   - Recycled Aluminum Manufacturing Process
2. Each course has six stations, shown in the charts.
3. Players carry a bucket from station to station trading the materials from the previous station to the more "processed" materials at the next.
4. A player finishes the manufacturing process by delivering five "finished" cans to the Soft Drink Bottling Plant, then runs back to Start and hands the bucket to the next player in line.

Procedure

1. Set up the six stations in each Process with materials outlined in the chart on next page.
2. Choose two teams of five or more students each for each round of the relay race.
3. Identify each station and what each of the materials represents.
4. Review the rules of the race.
5. Line up the players for each process and give the signal to start.
6. Continue until all players have delivered their cans to their Bottling Plant.
7. Compare the time (and energy) difference between producing cans from raw materials and from recycled cans.
8. Repeat rounds for other students in the class to participate.

Discussion Questions

1. Did the race turn out like you expected it to? How did your race compare to the time and energy of the real manufacturing process?
2. Why does it take more time and effort to manufacture cans from bauxite than from recycled aluminum?
3. What natural resources are saved when aluminum is recycled? Consider raw materials, transportation, manufacturing.
4. What natural resources are saved by recycling paper; glass; steel cans; plastic?
5. Considering how effective it seems to recycle, why is it better to reduce and reuse before recycling?

Related Pathways

1. Assign students to locate reliable information about aluminum manufacturing on the WEB. Possible starting points are the websites of the Aluminum Association (www.aluminum.org), ECONET (www.igc.org/igc/econet), and the federal Office of Industrial Technology (www.oit.doe.gov). After learning more about aluminum, and perhaps about technological developments, do they have any suggestions as to how the relay-race activity might be modified?

Mined Aluminum Manufacturing Process

The "optional detours" make the Mined Aluminum Manufacturing Process longer and more representative of the greater amount of energy needed than in the Recycled Aluminum Manufacturing Process.

Station	Distance from Last Station	Materials at Station	Process
1. Start	0		At the Start signal, run to Bauxite Mine.
2. Bauxite Mine	10 feet	5 bags of sand or cement block (one for each player); each bag also has 2 bricks	Place bag of sand in bucket and run to Refining Plant. OPTIONAL DETOUR: Carry the bag around a marker 10 feet from the Bauxite Mine and 10 feet back to the Refining Plant.
3. Refining Plant	10 feet (may include optional detour)		Remove the 2 bricks from the bag and put them into the bucket, run to Smelter. OPTIONAL DETOUR: Carry the bucket with bricks around a marker 10 feet from the Refining Plant and 10 feet back to the Smelter.
4. Smelter	10 feet (may include optional detour)	5 ingots (1 for each player); box for bricks	Remove the bricks, put them in the box and place one ingot in the bucket, run to Can Plant.
5. Can Plant	10 feet	25 cans (5 for each player); box for the ingots	Remove the ingot and put it into the box, count out 5 cans into the bucket, run to Bottling Plant.
6. Bottling Plant	10-20 feet	box for cans	Remove the cans and put them into the box, run to Start, tag next player.

Recycled Aluminum Manufacturing Process

Station	Distance from Last Station	Materials at Station	Process
1. Start	0		At the Start signal, run to Recycling Center.
2. Recycling Center	10 feet	25 crushed cans in a box (5 for each player)	Place 5 cans in the bucket, run to Recycling Plant A.
3. Recycling Plant A	10 feet	5 aluminum covered balls; box for the crushed cans	Remove crushed cans and put them in the box, put one ball in the bucket, run to Recycling Plant B.
4. Recycling Plant B	10 feet	5 ingots (1 for each player), box for aluminum covered balls	Put the ball in the box and put an ingot in the bucket, run to Can Plant.
5. Can Plant	10 feet	25 cans (5 for each player); box for the ingots	Remove the ingot and put it into the box, count out 5 cans into the bucket, run to Bottling Plant.
6. Bottling Plant	10-20 feet	box for cans	Remove the cans and put them into the box, run to Start, tag next player.

Awareness

Test the Alternatives

Level
- ● Beginning
- ■ Intermediate

Materials
- vinegar
- salt
- lemon juice
- baking soda
- vegetable oil
- bucket
- measuring cups
- spray bottle
- newspaper
- sponges
- rags
- water
- 6" x 8" index cards
- samples of commercial cleaning products
- cardboard box containing various commercial household cleaners
- handout for home

Key Question
How can we reduce the use of hazardous cleaning products at school and at home?

Overview
Students use recipes to mix nontoxic cleaning products that can be used around the home and school. Then they perform cleaning experiments to test the effectiveness of the cleaners on windows, desks, wooden furniture, and other surfaces.

Objectives
Students will identify the relative dangers of using common cleaning products, then test and compare the effectiveness of nontoxic cleaners.

Background Information
Many household products contain ingredients which can be hazardous to people or the environment. These ingredients can be poisonous, flammable, corrosive and/or cause violent chemical reactions. Hazardous products generally fall into five categories: Automotive products, cleaning and polishing materials, paint and related solvents, pesticides, and miscellaneous items (batteries, some cosmetics, shoe polish.) Unwanted portions of these products become household hazardous waste.

As with the management of all waste, the primary goal is to reduce the amount of waste that enters the waste stream, and then to provide for secure disposal. To do this, we all must be aware of which products we use at home and cut down on our reliance on those that contain toxic substances. We also need to dispose of the wastes responsibly.

Advertisers of household cleaners promise that our lives will be easier by using their products. Cleaning products are often time saving, yet they also contain hazardous ingredients. Because they are so common, we often use, store, and dispose of them without considering their dangers.

Cleaning products of greatest concern include: Drain openers/cleaners, furniture polish, rug cleaners, and products containing organic compounds and solvents. Disposal of cleaners is not usually as harmful to the environment as the disposal of paints, batteries, or motor oil since cleaners are usually diluted to safer levels when flushed down the drain. Excessive amounts can be dangerous, however, especially for household septic systems. Consumers often disregard label instructions, do not use adequate ventilation, and don't keep them out of the reach of small children. Aerosol sprays are easily inhaled from the air. The health effects of long term exposure to small amounts of these products are not known, however many do contain carcinogenic compounds.

Homemade cleaners can be made from common, inexpensive, nontoxic materials. They may not be as effective as commercial cleaners, however, since they often require more "elbow grease" and more frequent (preventative) cleaning to work effectively. Yet, in addition to being nontoxic and better for the environment, they cost about half as much as commercial cleaners.

Management Suggestions

1. Prepare a *handout for home.* Photocopy pp. 76 and 77 on two sides of a sheet and attach a different-colored half sheet orienting parents. Ask that children be given a tour of the household cleaning products and warn parents that the students are going to want to test at least one alternative at home.
2. Remind students of safety concerns: NEVER put cleaning products or the ingredients in the mouth.
3. Keep groups to 3-4 students each. Have several groups make and test the same recipe if necessary.
4. ● **Beginning:** Limit the recipes tested to scouring powder, window cleaner, and furniture polish.
5 ■ ◆ **Intermediate and Advanced:** Have them clean half of the surface with commercial cleaner and the other half with the home made alternative. Keep a chart comparing the cost, effectiveness, and relative harm to the environment for each of the cleaners tested.
6. Toxics is a tricky subject. Be sure to prepare yourself by reading **Background Information: Household Hazardous Waste** as well as "Information for the Expert" (pp. 50–53).

Procedure

1. Send handout home. On the next day discuss household cleaning chores and hold up containers for various commercial products used to do the chores. Are some of these products the same as those used at home?
2. Review the meaning of hazardous materials and discuss the dangers of toxic cleaners: Read the labels for contents, cautions and recommendations for disposal.
3. Display examples of the ingredients of nontoxic cleaning products. Ask students where they have seen baking powder, lemon juice, vegetable oil, and salt. Discuss how these items are commonly used. Compare the dangers of the commercial products and the nontoxic ingredients to people and the environment.
3. Read over the recipes for the alternative cleaning products. Discuss how to follow a recipe. Discuss measuring ingredients accurately.
4. In small groups have students use a recipe to mix a nontoxic cleaner. You may want to assign each group member to a specific task (measurer, tester, result reporter, etc.)
5. Assign a specific cleaning task to each group (washing windows, cleaning desks, polishing wooden furniture.)
6. When the cleaning jobs are finished, have each group report to the class or prepare a written report on how the cleaner worked.
7. ● **Beginning:** Hand out index cards and have students create recipe cards to take home. Younger students could decorate cards made by the teacher.
8. Have each student try at least one alternative cleaning product at home and interview their family about how the alternative product worked. Did they work as well as products from the store? Does the family agree that the nontoxic products are healthier for them and for the environment than the toxic ones? What are some of the disadvantages of the non-toxic products?

Adapted from AVR Teaching Toxics (1992)with permission from the Association of Vermont Recyclers, PO Box 1244, Montpelier, VT 05601; (802) 229-1833.

Discussion Questions

1. How can commercial cleaning products be harmful to the environment and people?
2. Why is it better for the earth to use nontoxic cleaning products?
3. Were the alternative cleaning products as effective as commercial products?
4. Do you or your family feel you should use commercial products instead of the nontoxic alternatives? Why? What pressure do you think advertising has on your feelings?
5. What choices were made in your grandparents' and great-grandparents' times? How have lifestyles changed? How have products changed? How has environmental awareness changed?
6. What can you do to help other people understand the dangers of toxic products and the advantages of nontoxic alternatives?

Related Pathways

1. Why not explore the potential of this activity to increase the awareness of not only students and their parents, but also the community at large? At the intermediate level students might consider **Promoting Alternatives to Hazardous Products**, or they might prepare a story for the local newspaper describing **Test the Alternatives** and focusing upon 2 or 3 of the nontoxic alternatives that students and families found most effective. At the beginning level, the local education reporter might be interested in doing a story.

Recipes for Alternative Cleaners

Scouring Powder (for desks, tables, and shelves)

For each desk mix together:
2 Tablespoons baking soda
1 teaspoon salt
Sprinkle on surface, use sponge to clean. Rinse desk with water on a sponge. Baking soda may leave a film so use plenty of water to rinse.

Furniture Polish (for wooden surfaces)

2 cups vegetable oil
1 cup lemon juice
In a container, mix oil and lemon juice together. Apply with a rag.

Window Cleaner

1/4 cup vinegar
4 cups warm water
Mix in a spray bottle. Spray on surface. Use newspaper to dry the glass, this prevents streaking.

A stronger, more smelly window cleaner:
3 Tablespoons ammonia
1 Tablespoon white vinegar
3/4 cup water
Mix in a spray bottle. Spray on surface, wipe with newspaper.

Air Fresheners/Deodorizers

Simmer cinnamon sticks and whole cloves in a small pan of water on top of the stove.

Sprinkle baking soda in odor-producing areas.

Sprinkle baking soda on carpet and vacuum after 30 minutes.

Sprinkle borax in corners of room.

Drain Cleaner

Pour 1/2 cup of baking soda, followed by 1/2 cup of vinegar, down the drain. Let stand for

15 minutes, then pour a teakettle of hot water down the drain. For this to be truly effective, you need to clean the drain every couple of weeks.

General Household Cleaners

1. Mix together 1 teaspoon liquid soap (castile peppermint), 1 teaspoon borax, squeeze of lemon juice and 1 quart warm water.
2. Mix together 1/4 cup of baking soda, 1/2 cup of borax, 1/2 cup of vinegar and one gallon of water.
3. For scouring, see Scouring Powder.

Laundry Detergent

Whenever possible, use soap instead of detergents.

To disinfect laundry use washing soda (sodium carbonate) in washer.

Floor Cleaner

Mix together 1/2 cup of white vinegar in a gallon of warm water. Polishing with skim milk after the floor is dry will make the floor glow!

Mildew Remover

Mix together equal parts of vinegar and water in a spray bottle, and use lots of elbow grease! Apply Borax directly to the mildewed area. This task requires maintenance cleaning. Cleaning once a week should keep mildew under control. Always spread your shower curtain out after showering.

Oven Cleaner

Mix together 2 Tablespoons of castile soap, 2 teaspoons Borax and 2 cups water. Apply the mixture and let sit for 20 minutes and scrub. This task requires maintenance cleaning. Add salt to heavy spills and clean immediately to prevent build-up.

Leave 1/4 cup ammonia in the oven overnight and wipe away grease the next morning. Ventilate the kitchen and avoid breathing fumes.

Floor Wax

Mix 1 part thick boiled starch and 1 part soap suds. Rub mixture on floor and polish with a dry cloth.

Wax Stripper

Pour a little club soda on the area, scrub well, let soak for 5 minutes and wipe.

Rug/Carpet Cleaner

Mix 2 parts cornmeal with 1 part Borax. Sprinkle liberally on carpet, leave on for one hour and vacuum. For stains blot with vinegar in soapy water.

Silver Polish

Put a piece of aluminum foil on the bottom of a pot; add water, 1 teaspoon baking soda, 1 teaspoon salt. Boil silver for 3 minutes, or soak for 10 minutes.

Brass Polish

Polish with Worcestershire sauce.

Copper

Soak in a solution of vinegar and salt

Toilet Bowl Cleaner

For stains make a paste of lemon juice and baking soda, let sit for 20 minutes, scrub with a brush. General: Mix 1/2 cup Borax in one gallon water, scrub.

Other suggestions for cleaners and alternatives to toxic products are available from

Chemicals in the Environment Information Office, University of Maine, 105 Jenness Hall, Orono, ME 04469 (207) 581-3201.

Environmental Hazards Management Institute, PO Box 932, Durham, NH 03824 (603) 868-1496.

Center for Hazardous Materials Research, University of Pittsburgh, 320 William Pitt Way, Pittsburgh, PA 15238 (412) 826-5320.

Assessment Pathways

How are we doing?

These waste inventories and audits help quantify the waste stream in school and in the home. There are many options for simple or detailed inventories, but every audit will help students learn about the types of waste they produce, and present opportunities for reducing that waste.

School Waste Audit ● ■ ◆ 76

School Hazardous Waste Audit ■ ◆ 80

Source Reduction/Recycling Quiz – Consumer Surveys for Students and Adults ● ■ ◆ 83

Home Waste Audit ● ■ ◆ 88

Home Household Hazardous Waste Audit ■ ◆ 90

Local Waste Management Options ● ■ ◆ 93

Trash Sorting Relay Race ● ■ 96

Landfill Siting Investigation ◆ 98

Assessment

School Waste Audit

Level
- ● Beginning
- ■ Intermediate
- ◆ Advanced

Materials

bags for collecting and separating trash

scale for weighing bags of trash

rubber gloves for each collector

data record sheets

Key Question
How much trash do we produce in our school?

Overview

Awareness pathways have prepared students for an inventory of the waste produced in your school. It involves collecting, separating, weighing, and analyzing trash. Forms are included for waste paper, junk mail, food waste and "other" materials. Depending on the group's needs, there are options for limiting the survey to a single classroom or including the entire school. The inventory can help identify priorities for ***action pathways*** *and it can be used as a baseline for measuring the success of future projects.*

Objectives

Students will measure the amount of waste produced in the school. They will determine the contribution each part of the school makes to the waste stream, and then find ways to reduce waste.

Background Information

A waste audit is an inventory of the trash produced in your school, home or business. When students realize how much trash they produce and then they see how much waste other people produce, they become committed to resolving the waste problem. Knowing what you throw away is the first step to reducing waste.

The waste audit is an important opportunity for your students to really get their hands on the waste problem. Even young students can get involved! A simple measure of the trash that is produced in your classroom or what goes into the dumpster in a day will raise the level of concern for both you and your students.

A careful waste audit allows you to gather "baseline data" without influencing the amount of trash that is thrown away. The audit results will accurately measure current patterns, and can be used to analyze improvements after waste reduction programs are in place.

Students can easily measure the amount of trash that they throw away each day in the classroom. As a check to the "big picture" you can weigh all the trash that goes into the school dumpster each day. The students may find that although your room only produces one half pound of trash per person, the school produces three pounds per person as a whole. Where is all the rest of that trash coming from? Are your students also responsible for that?

Management Suggestions

1. Coordinate the audit with the principal and custodian.
2. Your waste audit can be simple or complex. It is simplest to weigh bags of unseparated trash. Separating and weighing components of the trash provides detailed information, but takes more time. Decide which parts of the school you want to audit, and decide if you want to gather data for a day, two days, a week, or longer.
   - Classroom
   - Classrooms in your grade
   - Cafeteria and kitchen
   - Office, teacher's room, kitchen, bathrooms, other rooms in the school
   - All trash taken to the dumpster
3. If you can't inventory waste from the entire school, plan to audit the areas that produce

the most trash as well as your own classroom first. This will generate enthusiasm for reducing the worst sources of waste. Also, plan which types of trash you will measure. The Audit Charts are a guide, but there may be other categories that would be interesting.

4. It is helpful to gather the baseline data quickly so you can begin changing behaviors and reducing waste right away. However, the longer the collection period, the more accurate the data.
5. What will you do with the trash after collecting, separating, and weighing? Coordinate this pathway with the ***assessment pathway*** **Local Waste Management Options.** Determine what materials can be recycled in your town and separate the trash into appropriate categories.

Procedure

1. *Collecting*: Collect waste from various locations for one or two days, or for a week. Set up separate collection bins or boxes for different kinds of waste (paper, food, "other supplies"). This will make separating the trash easier and will help keep the trash cleaner. Using the attached forms, record where the trash came from and how long since the last trash collection. Collect trash from:
   - classrooms
   - "specials" rooms - art, science, music, industrial arts
   - office
   - teacher's room
   - cafeteria
   - kitchen
   - vending machine areas
   - bathrooms
   - custodian's facility
2. *Separating and Weighing*: Coordinate this activity with the custodial staff. The trash should be weighed as a whole and separated into categories: reusable, recyclable and non-recyclable. Students should work in pairs or in small groups as they separate trash. Reduce possible mess and accidents when separating the wastes by having students wear aprons, rubber gloves, and eye protection. Be particularly careful of dangerous materials like broken glass or household hazardous wastes. Notes should be kept about the trash which reflect the kind of wastes being thrown out, and the wastes that could be eliminated from the waste stream.
   Alternative: A less scientific, but much easier collection strategy is to follow the custodian on the trash pick-up rounds, look at and if possible weigh the trash. Visually estimate the percentage and different types of paper and other items in the trash.
3. *Analyzing the Data*: Your waste audit will help you determine how big a waste problem you have and the types of waste that are the biggest problem. You can determine which parts of the school are the biggest waste producers.
   a. Analyze the data using the math skills appropriate for your grade level. Graphs are helpful for understanding data like waste production - comparing locations or types of trash. A diagram of the school with waste production figures at various locations would be interesting.
   b. The data from the waste audit can be used to calculate the amount of trash generated annually, or the average amount generated by each individual. Calculate figures for daily/ weekly/ annual waste production and averages for each person/ class/ school. Students can also find percentages of various types of wastes.

Related Pathways

1. The audit numbers will make an impression on students and they will have a lot to say about what "people" should do. Help students with ideas of what they can do themselves about the waste they create in their own room and school, and how they can help others understand the problem. Consider action pathways **Simple Classroom Projects, Classroom Source Reduction, Cafeteria Source Reduction, Unsolicited Mail, Paper Reuse Campaign, Trash to Art Festival, Buy Recycled Campaign** (p.126) and the composting ***pathways.***

Waste Paper Audit

The waste paper audit measures the amount of paper that is thrown out. By separating reusable, recyclable and not recyclable paper you can determine the waste paper that can immediately be eliminated from the waste stream. First determine what kind of paper is accepted for recycling in your town.

Collection Date	*Location*	*# People using this site*	*# Days since last collection*	*Total Weight*	*Weight Reusable*	*Weight Recyclable*	*Weight Not Recyclable*

* *Notes about the non-recyclable materials (over packaged, individually wrapped, disposable items):*

"Junk Mail" Audit

"Junk mail" is unsolicited and unwanted (Are you sure it's unwanted by everyone?).

Collection Date	*Location*	*# People using this site*	*# Days since last collection*	*Total Weight*	*Weight of Magazines & Catalogs*	*Weight of Recyclable Paper*	*Weight Not Recyclable*

* *Notes about "Junk Mail" (which could be discontinued by notifying senders):*

Food Waste Audit

Collect food wastes from classroom snacks and the cafeteria (both cold and hot lunches). Keep these wastes separate from all other collections, and weigh while garbage is still fresh. Estimate the amount that is compostable.

Collection Date	*Location*	*# People using this site*	*# Days since last collection*	*Total Weight*	*Weight Compostable*

* *Notes about Food Waste (ideas of ways to reduce waste)*

Waste Audit of "Other Materials"

All "other materials" separated from the waste stream can be weighed and tabulated. Add other categories that apply in your town.

Collection Date	*Location*	*# People using this site*	*# Days since last collection*	*Total Weight*	*Weight Compostable*

**Notes about "Other Materials" Waste (household hazardous waste, including batteries; single-use disposable items; items that could be reused; ideas of ways to reduce waste):*

Assessment

School Hazardous Waste Audit

Level
■ *Intermediate*
◆ *Advanced*

Materials
variety of hazardous materials found in the school
MSDS sheets for those hazardous products
alternative products chart
audit record sheets

Key Questions
What hazardous wastes do we produce in our school? What should be done with them?

Overview
Awareness pathways have prepared students for an inventory of the hazardous waste produced in your school. The inventory involves locating, identifying, and recording hazardous products. Information from the audit can be used in decision-making to reduce hazardous materials and will help the district hazardous materials manager.

Objectives
Students will list the types and measure the amounts of hazardous materials in the school. They will analyze the role each department in the school plays in the use of household materials, and become motivated to find ways to reduce their use.

Background Information
See **Background Information: Household Hazardous Wastes.**

Whenever Hazardous wastes are the topic, students should be reminded that–because of the immediate danger they pose to the environment – they are handled with special caution and are governed by special regulations. However, the *Waste Management Hierarchy*--by which source reduction, reuse, and recycling are preferred–applies to hazardous waste as well.

Production and disposal of hazardous wastes are as much a problem in schools as they are for households. Schools use household and industrial strength cleaners, solvents, polishes, paints, and pesticides which can be hazardous to custodial staff, teachers, and students. These materials must be disposed of properly to avoid contaminating the environment. In addition, schools often stock hazardous chemicals for science, art, or vocational classes.

Schools are required to inventory all hazardous materials and maintain a file of Material Safety Data Sheets (MSDS) for the materials. The inventory and file is usually maintained by the maintenance supervisor for the school or district; the transportation manager sometimes has the responsibility, since the bus garage produces the greatest volume of hazardous wastes. Staff who handle hazardous materials are required by the Occupational Safety and Health Administration (OSHA) and state labor departments to be trained in the proper use, storage, and disposal of hazardous substances. Unfortunately, this training does not always involve the teachers and principals who order and use many of these materials.

Your school or district may have done a thorough inventory and clean-up of hazardous materials in 1989. The district may also be considered a "small quantity generator" of hazardous wastes and have a contract with a licensed handler to remove hazardous wastes (for products from the transportation garage, for example).

Management Suggestions

1. Introduce the topic of hazardous wastes with one or more of the ***awareness pathways*** **Getting to the Route of the Hazardous Waste Problem, Everyday Choices for a Sustainable Future,** and **Test the Alternatives.**
2. Plan the audit with the person responsible for maintaining the school or district hazardous materials inventory and MSDS file. Have that person help introduce the project to students. Do not duplicate the official inventory procedure.
3. Emphasize safety. Careful instruction and supervision for all participating students is critical. Containers should not be opened or shaken.
4. Decide which areas in the school will be included in the audit.
   - classrooms
   - "specials" rooms - art, science, music, industrial arts
   - office
   - teacher's room
   - cafeteria
   - kitchen
   - bathrooms
   - custodian's facility
   - transportation garage
5. Use the audit form from this activity or a form suggested by hazardous materials supervisor (e.g. Chemical Inventory Form used in the state inventory.) A separate list should be made for each room or location. The lists can help make the official inventory more complete.
6. Identify disposal options for hazardous materials in your town, and for your school.
7. Have students work in teams, each supervised by an adult.

Procedure

1. Review the issues surrounding hazardous wastes:
   - Many products we use contain hazardous ingredients.
   - Improper disposal can harm the environment.
   - There are limited approved disposal options.
   - Less harmful alternatives to many hazardous products are usually available.
   - We need to reduce production and disposal of hazardous wastes.
2. Brainstorm a list of hazardous products students think are used in the school. Discuss what makes these items hazardous.
3. Show some of the hazardous products from the school and discuss what makes them hazardous, how they should be handled, how they should be discarded. Refer to the Material Safety Data Sheets.
4. Examine the audit form and discuss the procedures for taking the school hazardous waste audit.
5. Review safety cautions and procedures.
6. Assign areas to be audited. Have teams conduct the audit.
7. When the audit is complete, all information should be provided to the manager of hazardous materials.

Analysis and Discussion

1. Identify the items listed on the audit sheets. Group the items according to what makes them hazardous (e.g. poisonous, flammable, corrosive, reactive.)
2. Discuss students' reactions to the materials they discovered. How hazardous are they?
3. How should different items be treated? Should they be disposed of? How?
4. Do all of these items need to be in the school? What alternative products are available?
5. What can students do to inform others about the dangers of hazardous wastes and the alternatives to using hazardous products?

School Hazardous Waste Audit

School_____ District_____ Inspected by_____

Room / Location_____ Inspection Date_____

Location	Name of Product or Material	Quantity	Type & Condition of Container	Why is it hazardous? (toxic, flammable, corrosive, reactive)	Comments

Source Reduction/Recycling Quiz

Consumer Surveys for Students and Adults

Key Question
How can we be part of the solution?

Level
- ● Beginning
- ■ Intermediate
- ◆ Advanced

Materials
- Copies of the survey form
- directions for scoring

Overview

This survey identifies buying habits and personal behaviors that create waste. Students can do the survey in class, and also take a version home for the family to complete. In each case the survey helps everyone to understand ways they can reduce the flow of the waste stream.

Objectives

Students will analyze their own purchasing and household habits and develop strategies to reduce waste.

Background Information

According to the US Environmental Protection Agency, packaging contributes 33% of the weight and 50% of the volume of municipal solid waste. Disposable ("nondurable") items make up another 28% of MSW. Nearly one dollar out of every ten that Americans spend on food and beverages pays for packaging.

Decisions consumers make every day affect more than the amount of waste they bring home from the store. These decisions influence the type of items grocers stock on the shelves, the recycled content of products, and even the items or the packaging that manufacturers produce for consumers. Looking at our buying habits and the ways we treat our trash is one of the first steps to taking action that will reduce waste and help us create a sustainable future!

Management Suggestions:

1. Review the items in the consumer surveys to be administered. Are there slight adjustments that would make them a better fit for your community, and thus a more effective teaching tool?
2. For younger students use the Consumer Survey for Students in class and have them take the other survey home for the family to complete. For the youngest students read the quiz aloud and have the them raise their hands for never, sometimes, or often. Discuss the terms and choices as you proceed. Have students count and keep track of the tally for each category.
3. Students could administer the quiz to other classes. Statistics can be generated for average scores for grade, classes, teachers, administrators. Compute averages, record on graphs.
4. Use the quiz as a pre/post test for student behaviors.
5. Use the responses to the survey to help set priorities for ***action pathways.***
6. Students can develop their own survey by brainstorming behaviors that promote waste reduction and conservation. They will enjoy giving their survey to others!

Procedure

1. Introduce the Source Reduction/Recycling Quiz by asking students how they think they contribute to the waste stream. Encourage them to be honest in answering the questions, that there should be no "competition" for a low or a high score. This quiz is a teaching tool to help them understand the choices they make every day which can help or harm the environment.
2. Pass out the quiz and have students complete it, then score it themselves.
3. Discuss each item on the quiz to determine how the action influences the waste stream.
4. Tally the total score for the class and find a class average.
5. Have students take the quiz home and give it to parents, relatives, and friends. Compare the scores with the class average, and discuss what they were able to teach others about waste reduction and recycling strategies.

Assessment

Discussion Questions

1. Which of the actions described on the survey don't require any more work or time? Which are the most difficult to do "often."
2. How can you convince yourself the actions are worth the effort? How can you convince others?
3. How do consumer choices (demands) influence store owners and manufacturers? Can talking to owners make a difference?
4. How else can you influence the choices of goods available in the stores?

Source Reduction/Recycling Quiz
Consumer Survey for Students

Think about the things you do that can help reduce waste. Circle the number in the column that says how often the question is true for you. Add up the circled numbers in each column to find your total score. Use the information in "Scoring the Survey" to rate your score.

	never	some of the time	often
1. Do you wear hand-me-downs or buy second-hand clothes?	3	2	1
2. Do you make sure to put the tops back on markers so they don't dry out and you don't have to buy new ones more quickly?	3	2	1
3. Do you take good care of toys and personal belongings so they won't break and you have to throw them out?	3	2	1
4. Do you use envelopes from junk mail or reuse old envelopes to carry lunch money, book orders, or notes to school?	3	2	1
5. Do you write or draw on the back of paper that has already been used?	3	2	1
6. Do you borrow books from the library or swap with your friends to avoid buying new books and magazines?	3	2	1
7. Do you use toys or games that don't need batteries or use electricity?	3	2	1
8. Do you ride your bike or walk to visit friends rather than driving in a car and using gasoline?	3	2	1
9. Do you turn off lights, television, and radios when you are not using them?	3	2	1
10. Do you avoid buying individually wrapped snacks for school?	3	2	1
11. Do you reuse plastic bags or containers when you bring lunch or snacks to school?	3	2	1
12. Do you recycle the things that can be recycled in your community?	3	2	1
13. Do you have a compost pile or a worm bin for your garbage at home?	3	2	1
14. Do you bring your own shopping bags to the store?	3	2	1
15. Do you talk to your friends or family about reducing, reusing, or recycling?	3	2	1
Column Totals	___	___	___
Grand Total			___

Source Reduction/Recycling Quiz
Consumer Survey for Older Students and Adults

Every day we make choices that affect the amount of waste we produce. Consider your behavior, the choices you make and your contribution to the waste stream. Add up the circled numbers in each column to find the column totals, then add them together to find your total score. Use the information in "Scoring the Survey" to rate your score.

Do you ...	never	some of the time	often
1. choose to buy an item because it has less packaging?	3	2	1
2. consider the recyclability of an item before you buy it?	3	2	1
3. choose not to buy some things you want because you don't really need them and it would be wasteful?	3	2	1
4. think about what will happen to a product or a package when you no longer have any use for it?	3	2	1
5. try to reuse things you already have rather than buy new products?	3	2	1
6. wash out and reuse plastic bags in your home?	3	2	1
7. consider what pollution and wastes were created in the manufacture of the things you buy?	3	2	1
8. use the recycling facilities in your community?	3	2	1
9. use dishcloths, sponges and cloth napkins instead of disposable paper products?	3	2	1
10. avoid items such as disposable diapers, razors, lighters and pens when longer lasting alternatives are available?	3	2	1
11. ask that less wrapping be used when you order take-out food?	3	2	1
12. compost kitchen waste and other decomposable organic matter?	3	2	1
13. bring your own shopping bags to the store?	3	2	1
14. buy items from bulk supplies in the store?	3	2	1
15. talk to store managers about stocking bulk items and avoiding packaging?	3	2	1
16. spend the money to repair an item even though you could get a new one for nearly the same price?	3	2	1
17. look for and buy products made from recycled materials?	3	2	1
18. return beverage containers rather than put them in the trash?	3	2	1
Column Totals	___	___	___
Grand Total			_____

Assessment

Scoring the Survey

Consumer Survey for Students

If your score was:

36 OR MORE

Like most people you are throwing more trash away than you need to. It's easier to tell other people what they should do than it is to change your own habits. If you learn how to make less waste in the first place, you will be part of the solution!

What can you do? Be aware of the amount of trash you generate each week. Not how heavy it is, but how much of it could be reused, recycled or avoided entirely. Next time you go to the store, check to see if any of the products you normally buy in non-recyclable containers are also available in reusable, refillable or recyclable containers. Avoid products with excessive packaging. Reuse your paper and plastic bags when you shop or take your own cloth or string bags with you.

BETWEEN 23 AND 35

You are making an effort to reduce waste! Can you do these things more often and think about other things you can do?

What else can you do? Look carefully at the things you throw away: Is there any way you could reuse containers or wrappings? Better yet, is there a way you could have not gotten those items in the first place? Talk to other people about how they reduce, reuse, and recycle.

22 OR LESS

You're obviously working hard to reduce waste. It shows!

Think about the things you do to keep trash out of the waste stream. Which are you most proud of? Encourage your friends and family to consider doing the same. Help get projects started in school and at home to make your work even more effective. Keep up the good work!

Consumer Survey for Older Students and Adults

If your score was:

44 OR MORE

Like most people, you are probably contributing your full share of trash to our rapidly diminishing landfill space including tons of usable, recoverable materials. By your consumer habits you are also encouraging manufacturers and storekeepers to market wasteful products and packaging and discouraging markets for recyclable goods.

What can you do? Be aware of the amount of trash you generate each week. Not how heavy it is, but how much of it could be reused, recycled or avoided entirely. Next time you go to the store, check to see if any of the products you normally buy in non-recyclable containers are also available in reusable, refillable or recyclable containers. Avoid products with excessive packaging. Reuse your paper and plastic bags when you shop or take your own cloth or string bags with you.

BETWEEN 29 AND 43

You are making an effort to reduce waste! Reducing, reusing and recycling patterns need to be practiced consistently by the majority of the population if we are going to make a dent in the increasing amounts of waste.

What more can you do? Do some comparison shopping. Consider various types of packaging and the alternatives that are available. Consider buying products in larger quantities or in bulk quantities. Reuse your paper and plastic bags when you shop or take your own cloth or string bags with you.

29 OR LESS

You've obviously done some serious thinking about the need for resource conservation. It shows!

Think about the things you do to conserve. Which are you most proud of? Encourage other people to consider doing the same. Get involved in solid waste planning in your community. Keep up the good work!

Adapted by the Chewonki Foundation, the Natural Resources Council of Maine and the Maine Waste Management Agency Office of Waste Recycling and Reduction, from the Rhode Island Dept. of Environmental Management, Waste Education Curriculum and the Oregon Dept. of Environmental Quality, Solid Waste Division. The Student Survey was developed by Helen Sahadi, Thorndike, Maine.

Assessment

Home Waste Audit

Key Question
How much trash does my family generate?

Level
- ● Beginning
- ■ Intermediate
- ◆ Advanced

Materials
- bags for collecting and separating trash
- gloves
- data record sheets
- class chart

Overview

This is an inventory to help students and their families determine how much waste they generate at home. It involves having each household collect, separate, weigh, and analyze their trash. A form is included for recording data from the audit. Separate forms for recording food waste and junk mail are also included. The audit can be designed for any reasonable time period. The inventory can help identify priorities for ***action pathways*** *and it can help motivate students to reduce waste outside of school.*

Objectives
Students will identify the types of waste and the amount of waste produced at home. They will identify strategies to help their families reduce waste.

Background Information
The U.S. Environmental Protection Agency estimates that in 1998 each person in the country contributed 4.3 pounds to the stream of Municipal Solid Waste (MSW.) This figure is an average of the waste produced by households, businesses, government offices, and schools. Most individuals produce less than the average 4.3 pounds per person, yet each one of us should still ask "How much waste do I create?" and "How can I create less waste?"

The home waste audit is a starting point for students and their families to evaluate their own contribution to the Municipal Solid Waste stream and take action to reduce!

Management Suggestions
1. Review the Household Waste Audit Data Form. Are there slight adjustments that would make them a better fit for your community, and thus a more effective teaching tool? For example, what are the categories of paper and plastic recognized at your local recycling center?
2. Communicate with parents to get their support for the home audit. Emphasize to students and parents that this is not a "contest," but a way for families to stand back and take a look at their contribution to the waste stream. An adult should be encouraged to help students at home to ensure safety and cleanliness.
3. Decide on an amount of time for the home audit. If two weeks is chosen the Data Form allows for four measurements during the two weeks.
4. Have students bring data forms to school after every measurement and make entries on a class chart, which might reflect class totals, or individual family totals, or both. Compare waste production at home to waste production at school.

Procedure
1. Define MSW and discuss the items each household contributes to the waste stream. For a more complete description of MSW, see Background Information Overview.
2. Identify the sorting categories listed on the form. Separate the items according to the categories of recyclable material accepted by your local recycling center. For example, be sure your definition of "office" paper is consistent with the paper accepted by the center.
3. Review the process of collecting and weighing trash at home (use suggestions in the School Waste Audit activity.) Emphasize working with an adult, and ensuring cleanliness and safety. Look over the data form to familiarize students with the categories.
4. Have small groups practice the process by separating and weighing classroom or other school trash.
5. Analyze the data as described in the School Waste Audit activity.

Household Waste Audit Data Form

Household Information

Name_____(Circle one) house or apartment

Address _____

Phone_____ Number of people in the household and their ages _____

What pets do you have?_____ Do you have a yard? _____ How large?_____

What do you usually do with your yard waste (compost, transfer station, stump dump, garbage pickup)?_____

Do you currently recycle? _____ If yes, what materials? _____

Waste Data

1. Estimate the annual amount of the following waste that your household generates.

tires _____ white goods (large appliances) _____

stump dump material (stumps, wood, trees, etc.) _____

yard waste (grass clippings, brush leaves, etc.)_____

2. Household waste data Date Start _____ Date Finish _____

	Weight	Days	Weight	Days	Weight	Days	Weight	Days
newspaper								
"office" paper								
mixed paper								
magazines & catalogs								
recyclable HDPE #2 plastic								
other plastics								
glass								
aluminum								
tin cans								
food waste								
corrugated cardboard								
# bags yard waste								
other (diapers, etc.)								

This form was adapted from the form used by the Yarmouth, Maine Waste Reduction and Recycling Committee.

Assessment

Home Hazardous Waste Audit

Level
■ *Intermediate*
◆ *Advanced*

Materials
hazardous products collected from the school (for demonstration)
Household Hazardous Waste Audit Form
alternative products information sheet (See Test the Alternatives)

Key Questions
What household hazardous materials do I have in my home? What should I do with them?

Overview
Awareness pathways *have prepared students and their families to determine the household hazardous substances they use, store, and discard at home. The inventory involves locating, identifying, and recording household hazardous products. The audit can help families develop strategies to reduce their dependence on hazardous materials. Special precautions must be followed to ensure student safety during the audit.*

Objectives
Students will identify hazardous materials found in the home; they will understand the dangers of improper disposal of household hazardous wastes; they will identify ways to reduce household hazardous wastes.

Background Information
Whenever hazardous wastes are the topic, students should be reminded that–because of the immediate danger they pose to the environment–they are handled with special caution and are governed by special regulations. However, the *Waste Management Hierarchy*, by which source reduction, reuse, and recycling are preferred, applies to hazardous wastes as well.

Many household products contain ingredients which can be hazardous to people or the environment. These ingredients can be poisonous, flammable, corrosive and/or cause violent chemical reactions. Hazardous products generally fall into five categories: automotive products, cleaning and polishing materials, paint and related solvents, pesticides, and miscellaneous items (e.g. batteries, some cosmetics, shoe polish.) Unwanted portions of these products and their containers become hazardous waste.

The products most likely to contain hazardous materials include (but are not limited to):

Cleansers
(the most hazardous examples)
- ***furniture polish***
- ***oven cleaner***
- ***drain opener***
- ***spot removers***
- ***toilet bowl cleaner***

Car Products
- ***motor oil***
- ***antifreeze***
- ***car batteries***

Pesticides
- ***flea powder/collar***
- ***insect repellent***
- ***weed killer***
- ***garden insect spray***

Paint and Paint-Related Products
- ***paint***
- ***wood preservative***
- ***wood stain***
- ***paint brush cleaner***

Other Household Products
- ***ni-cad (nickel-cadmium) batteries***
- ***small, sealed lead-acid batteries (as used in emergency lighting)***
- ***shoe polish***
- ***fingernail polish and remover***
- ***rubber cement***

Improper use, storage, and disposal of hazardous products can cause serious environmental problems. If they are not completely used or disposed of in an approved hazardous waste facility, most hazardous wastes eventually seep into waterways or into the ground water. There are local and state collection programs for the disposal of waste oil, batteries, and waste paint.

Management Suggestions

1. Consider the ***awareness pathways*** on household hazardous waste and the ***assessment pathway*** **School Hazardous Waste Audit** before starting off on this pathway.
2. Communicate with parents to get there support for the home audit. Make it clear that this is an optional activity for students which they should undertake only under the supervision of an adult. Ask parents to sign a form indicating their willingness to assist with audit.
3. *Students should not be made to feel any competition, or that they will be embarrassed by identifying hazardous materials they may have in their homes.* The goal of the exercise should be to get accurate information and generate solutions for dealing with a difficult community problem.

Procedure

1. Review the issues surrounding household hazardous wastes.
   - Many products we use contain hazardous ingredients.
   - Improper disposal can harm the environment.
   - There are limited approved disposal options for households.
   - Less harmful alternatives are usually available.
   - We need to reduce production of household hazardous wastes.
2. Brainstorm a list of hazardous products students think they have in their homes. Discuss what makes these items hazardous.
3. Examine the audit form and discuss the procedures for taking the household audit.
4. Review the cautions listed on the form. Emphasize parent approval and participation.

Analysis and Discussion

1. Combine lists to identify the most common products in students' homes.
2. What makes the materials listed hazardous?
3. How should different items be disposed of?
4. What alternative products are available?
5. What can students do to inform others about the dangers of household hazardous wastes and the alternatives to using hazardous products?

Home Hazardous Waste Audit

Student Name _____ Audit Date _____

Adult Signature _____

Complete this audit with an adult member of your family. Do not open any hazardous product containers: use the information on the labels. Check the locations in your house where hazardous products might be stored. Look in the kitchen, bathroom, laundry room, cellar, garage.

The products most likely to contain hazardous materials include (but are not limited to):

Cleansers (the most hazardous examples)
- furniture polish
- oven cleaner
- drain opener
- spot removers
- toilet bowl cleaner

Car Products
- motor oil
- antifreeze
- car batteries

Pesticides
- flea powder/collar
- insect repellent
- weed killer
- garden insect spray

Paint and Paint-Related Products
- paint
- wood preservative
- wood stain
- paint brush cleaner

Other Household Products
- household batteries
- shoe polish
- fingernail polish and remover
- rubber cement

Location	*Product Name and Use*	*How often is it used?*	*Why is it hazardous? (toxic, flammable, corrosive, reactive)*	*What safer alternative could be used instead?*

Check to see which household hazardous wastes are collected (for reuse, recycling, or disposal) in your town or nearby. Consider using alternative products in the future.

Local Waste Management Options

Key Question

If there is no such place as "away," where does our trash end up?

Level

- ● *Introductory*
- ■ *Intermediate*
- ◆ *Advanced*

Materials

Local Waste Management Options flow chart

Overview

Each town or region has different facilities for processing trash. The "rules" for recycling vary greatly from place to place. This activity helps students identify exactly what happens to their trash. The people who handle trash and recyclables visit the classroom, or the students go on field trips to visit facilities that handle their trash. Students mark on a flow chart the route each type of trash or recyclable takes.

Objectives

Students will identify the final destinations of different kinds of wastes in their community and the routes all of their trash takes after it is thrown "away."

Background Information

Every community disposes of solid waste, but no two communities do it in exactly the same way. Most citizens don't know what happens to their waste after they throw it "away." Before they can really appreciate the need to produce less waste, and make the effort it takes to change consumer patterns, every person should know what happens to each type of waste they create. How much of their waste is recoverable, how it is recovered, and how much is "unrecoverable?"

Unrecoverable waste is sent to a landfill or incinerator. Where is your landfill? What incinerator does your town use? Options are being developed for recyclable, compostable, and returnable (redeemable) materials. Most communities have programs to recycle some types of waste. What is recyclable in your town? Where do these things get recycled? Can you get yard waste or food waste composted? Several states now have returnable container laws, so that many types of containers are redeemed for deposit. Where do the bottles go after you take them to the redemption center? Answers to these questions will help clarify how waste is managed in your community.

Management Suggestions

1. Talk with the town (or regional) solid waste manager to understand the waste options in your area.
2. Work with your custodian to learn about how the school trash is handled: Who is the hauler? Where is the trash taken?
3. Plan a field trip to your recycling center, transfer station, and a redemption center, or invite operators of each to discuss where the trash goes in your town. Consider inviting the custodian and trash hauler.
4. Plan a field trip to the landfill or incinerator where the trash from your town is sent or invite an operator to show slides of the facility. Learn how the facility is managed and determine what happens to most of your trash when it is thrown "away." The background information sections on Landfilling and Incineration describe what happens in each type of facility.

Assessment

Local Waste Management Options

Procedure

1. Brainstorm ideas with students about where their trash goes. Try to get their ideas of the steps it takes to get to the "final resting places" of different types of trash.
2. List questions that students have and decide how they can get their questions answered.
3. Take a field trip or invite speakers to provide information for students.
4. Using the flow chart, have students color in the arrows to show the pathways of the different types of trash. Color in only the pathways that are available in your community. Write in the details (name of the recycling center, trash hauler, etc.) for your town. List examples of reusable items.

Discussion Questions

1. Can you really throw your trash away?
2. Where is the landfill or incinerator used by your town?
3. How do recyclables get recycled?
4. What compostables can be recovered? How?
5. What happens to returnables after you take them to the redemption center?

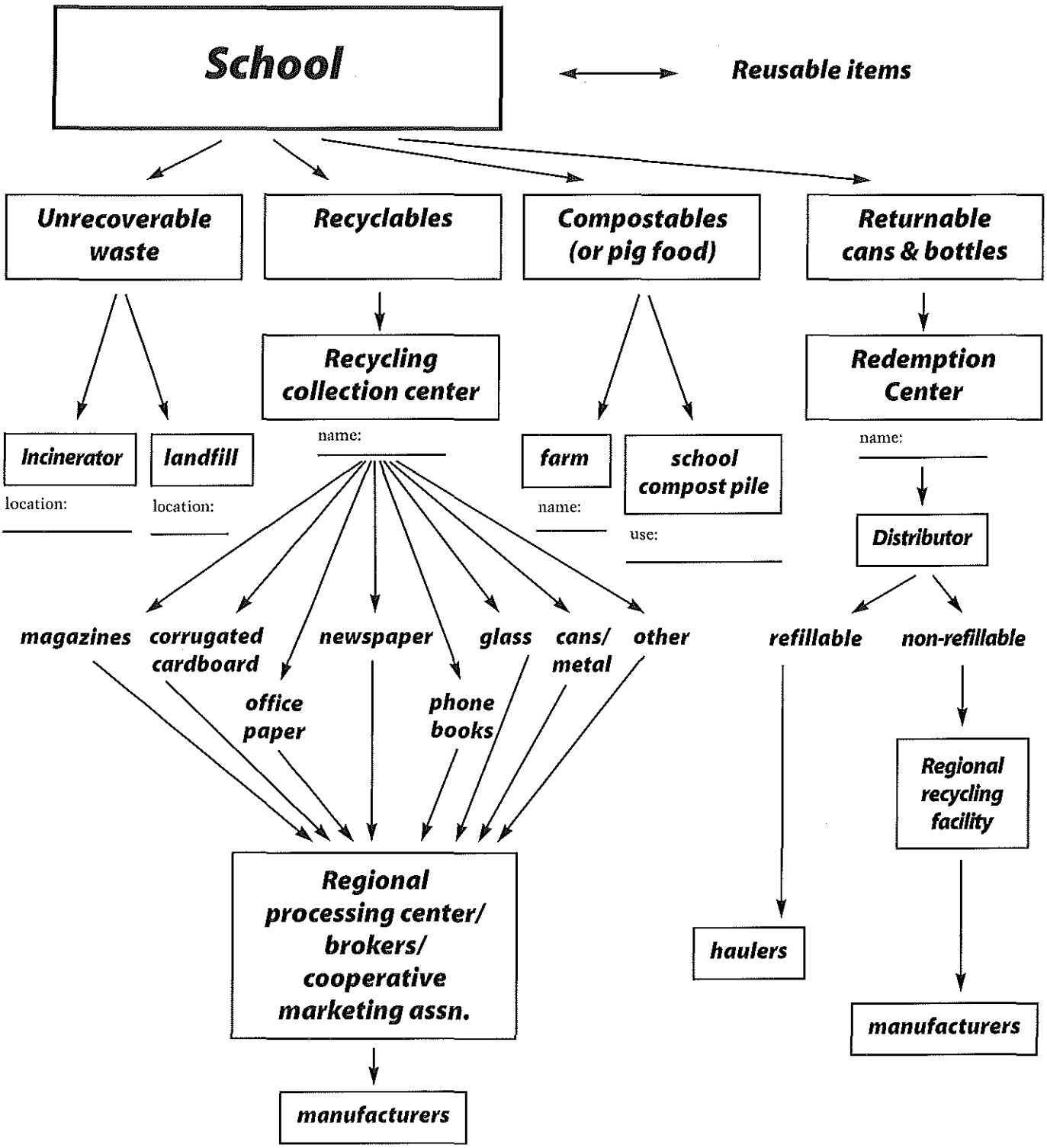
Related Pathways

1. Does your local government or recycling center have available for widespread distribution a brochure or handout which informs residents which materials are accepted for recycling, gives the center's hours of operation, and provides other tips for beginning recyclers (bundling, crushing, removing labels and caps, etc.)? If not, could the class work with local officals to design and publish such a brochure?
2. Consider **Trash Sorting Relay Race**. Also consider ***action pathways*** such as **School Recycling Program** and **Home Recyclables Collection Center.**

Local Waste Management Options Flow Chart

Student name: _____
School: _____
Town: _____

Directions: Color the arrows to show where each type of trash in your town goes. Write in details of the names of the facilities in your town.



Assessment

Trash Sorting Relay Race

Level
■ Intermediate
◆ Advanced

Key Question
How is trash separated in our community?

Overview

This active pathway is a good follow-up to ***Local Waste Management Options****. The challenge is for students to separate a pile of trash into categories for recycling, reuse, composting, or disposal. The categories are set according to the services available in your own town. The activity reinforces the students' knowledge of proper separation and prompts discussion about techniques for reducing waste.*

Materials

gloves (cotton work, large)
1 pr. for each team

boxes (5 for each team) labeled:
To the landfill *or* **To the incinerator**
(your local) Recycling Center - *separate this box in to sections for specific recyclables if you like*
Redemption Center
Miscellaneous Reusables: art, science, craft projects; storage containers
Compost

1 large trash bag filled with a variety of cleaned/dry trash for each team

paper - school paper with one blank side, envelopes with plastic windows, junk mailings, magazines, newspapers, paper bags, glossy paper, paper plates, cups, napkins

cardboard and paperboard - cereal boxes, egg cartons, etc.

plastics - yogurt containers, milk jugs, shampoo bottles, plates, utensils, packaging, plastic bags, balloons, etc.

glass - sturdy bottles (like salad dressing)

returnable cans and bottles - plastic, glass, aluminum

tin cans - soup cans, spice containers, aluminum foil

disposables - diapers, broken toys, scraps of cloth, etc.

polystyrenes - foam meat trays, foam cups, etc.

solid biodegradables such as peelings or tea bags

NOTE: Any multi-layered packaging is a great stumper

Objectives

Students will distinguish recyclable and nonrecyclable materials and identify recycling categories of material which is recyclable in their town. Students will identify strategies to reduce the amount of waste destined for the landfill or incinerator.

Background Information

Each town has a specific trash collection and separation procedure. This activity should model the separation process used in your town. Label the collection boxes to correspond to the categories collected curbside, at the transfer station, at the local recycling center, redemption center, or other facility. Determine the destination of non-recyclable wastes - landfill or incinerator.

Management Suggestions

1. Two teams can compete against each other or one team can race against the clock.
2. Allow enough cleared space for the teams to run and place the items in the boxes.
3. Line up the boxes so that each team can read the choices for waste disposal.
4. Explain that whenever one handles trash, gloves should be worn. Discuss why (hygiene, safety, etc.)
5. Present awards to each team or team member to recognize their commitment to waste reduction.

Procedure

1. Team members stay behind the designated starting line.
2. Place a full bag of trash for each team between the starting line and the boxes.
3. Announce the process to each team:
   a. The first person in the line puts on the gloves, then reaches into the bag and pulls out two items.
   b. The player then runs to the boxes and decides how to dispose of both items. He or she may consult with team members if necessary.
   c. When the items are in the proper boxes, the player removes the gloves and hands them to the next team member.
   d. The race is over when all the items from one team's bag have been placed in the boxes. You may want to end the race when even the large trash bag has been placed in a box.
4. Examine the contents of each box and discuss the results.
5. Develop ***action pathways*** which promise to reduce the amount of trash the class sends to the dumpster.

Discussion Questions

1. Which boxes got the most waste? Which got the least? What does that tell us about our waste?
2. What items were students unsure about? Could some items have been put in a different box?
3. How can we reduce the amount of trash in the landfill (or incinerator) box? (What alternatives to those products or packaging do we have?
4. What items do we generate in the classroom (school) that could be removed from the landfill (or incinerator) box? What should we do with them?
5. What else can we do to reduce the amount of trash we generate?

Related Pathways

1. Could the services available in your community be compared to the services available in an adjacent community? How would the contents of the boxes be changed?

Adapted from an activity designed by Bob Olney, teacher at Waynflete School in Portland, Maine.

Assessment

Landfill Siting Investigation

Level
◆ *Advanced*

Materials
Municipal maps showing:
-general detail
-surface water and land suitability
-soil-type
-topography

Overview

This is a research and planning project in which students try to identify an appropriate landfill site within local boundaries. Students use the same major criteria that state officials use in making landfill siting decisions. They also wrestle with the emotional issues that emerge in most real town siting proposals. The class concludes by proposing, defending, and voting on a specific site for locating the landfill.

Objectives

Students will understand the criteria, and the process, used in their state and municipality for approving a landfill site. They will locate sites and features on detailed maps, and use scales to measure distances. They will determine the appropriateness of various sites according to several criteria.

Background

See **Background Information: Landfilling.**

Landfill Siting Criteria

When any state agency or municipality looks for a new landfill site, they must follow certain guidelines as to where the landfill will be located. There are two different types of guidelines: *Exclusion criteria*, which specify where landfills *cannot* be located, and *Preference criteria*, which specify where it would be *best* for landfills to be located. The table below is a simplification of the actual landfill siting criteria used in the state of Maine, established by Maine Revised Statutes Annotated Title 38. Given a specific issue, the table answers the question, "According to this criterion, where can the landfill be located?"

Planning Considerations

1. Consider this ***pathway*** even if landfilling is no longer thought feasible in your area. It will be valuable for students more fully to understand why.
2. Make contact early on with a knowledgeable local or state official who can serve as a "class consultant" on this ***pathway.*** If you are not in Maine, get this person's help in adjusting the landfill siting criteria on the chart (this may mostly involve changing distances).
3. The most important resource for this project is a detailed municipal map showing a clear scale. Secure such a map in advance from local officials. A simple map showing major lakes, streams, roads, and possibly buildings will be best. A separate copy of the map will be necessary for each group of students (and it may be helpful for each group to have more than one copy). Ideally, each group would have a transparent overlay of the municipal map to work with.

Exclusion	*Issue*	*Notes*	*Preference*
SURFACE WATER CONCERNS			
not within 300 ft.	Proximity to surface water source (rivers, brooks, streams, lakes)	1,2	not within 1000 ft.
not within 300 ft.	Proximity to coastal or freshwater wetland (tidal or freshwater marsh, bog, swamp)	1,2	not within 1000 ft.
not on 100-year floodplain	Potential for coastal or freshwater flooding	5	not on 500-year floodplain
GROUNDWATER CONCERNS			
not located in soil type A or B (gravel or sand)	Proximity to sand or gravel deposits and aquifers (soil types A and B)	3,4	not within 300 ft.
GEOLOGIC CONCERNS			
not in an unstable area; no landslides or mudslides	Stability of land (Optional - may be difficult to determine!)	6	not within 200 ft. of a fault
no exclusion criteria	Grade of landfill site	2	not more than 8%slope (80 ft. rise in 1000 ft. distance)
WILDLIFE, NATURAL AREAS CONCERNS			
not in wildlife preserves, etc.	Proximity to wildlife management areas, preserves, refuges, and sanctuaries	1,2	not within 1000 ft. of preserves, etc.
not in these areas	Proximity to areas of significant wildlife habitat, critical areas, 'fragile' mountain areas, 'unusual' areas	1,2	not within 300 ft. of these areas
not within 1000 ft.	Proximity to state and federal park boundaries, Appalachian Trail	1,2	not within 2,640 ft.
not within 1320 ft.	Proximity to major lakes	1,2	not within 2,640 ft.
OTHER CONCERNS			
not in these areas	Proximity to federally-owned or non-profit-owned land preserves	1	not within 1000 ft.
not in these areas	Proximity to National or State Historic Sites and significant archaeological sites	1	not within 300 ft.
not within 1 mile	Proximity to FAA licensed airport	1,2	not within 2 miles
no exclusion criteria	Proximity to Primary Viewing Locations (the ocean, islands, parks, AT, ponds, rivers, scenic or interstate highways)	1,2	not visible

Notes:
1. Information available on town maps.
2. Information available on topographical maps.
3. Information available on Soil Conservation Service Soil type maps.
4. Information available on Town Land Suitability maps.
5. Information available from town historical records, oral histories.
6. Information available from state geological maps.

Additional maps will be essential resources, including:

- Surface water and "land suitability" maps from the municipal office;
- Soil-type maps from the Soil Conservation Service, (listed by region in the phone book under United States Government, Department of Agriculture);
- Topographical maps from your municipal office or state planning agency; If all of the recommended maps are not available, parts of the ***pathway*** can be modified or eliminated.

4. Students might be asked to use out-of-class time in following this ***pathway,*** which will lead different students in different directions.

Suggestions for a Successful Investigation

1. Divide the class into approximately five small groups. Each group will be responsible for investigating one set of concerns, as listed in the siting criteria.
2. Each group will need to determine which areas in the town are not suitable for a landfill (excluded or "preferably excluded") based on their assigned concerns. For example, the group investigating surface water concerns will need to use maps to find all the year-round surface water in the town. The group investigating geologic concerns will need to use maps and other resources to find all places in the town with a grade of greater than 8%.
3. The final goal for each group will be to produce a marked-up copy of the basic town map that indicates areas from which a landfill would have to be excluded (based on their specific concerns) and where it would be "preferably excluded." It is recommended that each group be assigned a different color. **Excluded areas should be colored with a solid color; preferable exclusion areas should be darkened with cross-hatching.** [For example, the group focusing on wildlife concerns would color in all areas on their town map that are wildlife refuges, preserves, sanctuaries, or management areas in solid yellow; they would cross-hatch all areas within 1000 feet of these regions with yellow. The group investigating surface water concerns would color in all surface waters with solid blue on *their* town map; they would cross-hatch all areas within 1000 feet of surface waters with blue.]
4. In some cases, it will not be clear exactly where the land meets certain criteria. For example, it can be very difficult to determine, even with the best information, where a geologic fault lies. It may be unclear whether a certain landfill site would be visible from the highway. These difficulties are also encountered by state officials in the process of siting a landfill! Students should be encouraged to make the best decisions they can in the face of uncertainty, and to note the basis for their decision for later discussions. In general, it will be better for them to exclude more land from consideration than to include too much.

5. When all groups have marked up their respective maps, they should display them individually, and a composite town map should be constructed that combines all "excluded" and "preferably excluded" areas for each of the siting concerns. The result will be a colorful map; all white (unmarked) areas on the composite map represent preferred landfill sites. (If transparent map overlays are used for the project, they can easily be combined to form the composite map.)
6. Perhaps your "class consultant" will be able to help the class understand how your State's landfill siting criteria address the whole area of *land use*. Are municipal zoning laws or comprehensive plans taken into account? Can privately owned lands be used? What other factors might be taken into account when choosing a site for a landfill?
7. With the composite map complete and on display, discuss with the whole class where the best locations for a landfill are inside the town limits. Assume that a moderate-sized landfill needs to be constructed in the town covering approximately 20 acres, with a total land requirement of 100 acres for a sizable buffer zone. (Note that the buffer zone would not need to meet exclusion restrictions.) This will require approximate dimensions of 2000 feet by 2000 feet. Draw a square of this size (to scale) on a corner of the town map so that students can visualize how much land is necessary.
8. As the discussion proceeds, consider the question of general public involvement in landfill siting. Does your State's siting process require public hearings, or other forms of public involvement? Why might local residents want to be involved? Encourage students living in neighborhoods near one of your potential sites to express any concerns his family or his neighbors might have.
9. After sufficient discussion, take a class vote on which of the potential sites is the best one for a landfill.

Discussion and Follow-Up

- How easy was it to find a suitable landfill site based on the state guidelines?
- Were any sites found that all students agreed upon?
- Did your municipality once have a landfill, or does it have one now? Where is it located? Is it in a place that meets all siting criteria?
- Be sure that notes are written thanking those who helped with the research.
- The class or group within the class might prepare a report of your investigation and send copies to state and local officals concerned with landfill siting.

Action Pathways

Action projects to make a difference

This section contains a number of action steps that students can undertake. They all help effect change in the way we think about and manage waste. Some activities focus on the classroom, some are directed towards the school at large, and some deal with waste management issues at home and in the community. Their collective goal is to involve students and teachers with real issues and creative solutions to our current waste management problems.

Simple Classroom Action Projects 104

Source Reduction Projects
1 *in the Waste Management Hierarchy*

Classroom Source Reduction Campaign ● ■ ◆ 106

Cafeteria Source Reduction Campaign ● ■ ◆ 107

School Source Reduction Publicity Campaign ● ■ ◆ 109

Unsolicited Mail: "Who's In Charge Here? ● ■ ◆ 111

Promoting Alternatives to Hazardous Products ■ ◆ 115

Reuse Projects
2 *in the Waste Management Hierarchy*

Classroom and Office Paper Reuse Campaign ● ■ ◆ 116

Used Clothing Drive and Swap ● ■ ◆ 117

Magazine Reuse Campaign ● ■ ◆ 118

Trash-to-Art Festival ● ■ 119

Waste Paint Exchange Project ■ ◆ 120

Recycling Projects

3 *in the Waste Management Hierarchy*

School Recycling Program ● ■ ◆ 122

"Buy Recycled" Campaign ■ ◆ 124

Home Recyclables Collection Center ■ ◆ 128

Battery Use Reduction and Rechargeable Battery Promotion ■ ◆ 130

Composting Projects

4 *in the Waste Management Hierarchy*

Classroom Worm Bin Project ● ■ 132

Cafeteria Composting Project ● ■ ◆ 135

Plans for Constructing Composting Bins 138

Wire Mesh Holding Unit 138
Wooden Pallet Holding Unit 139
Wood-and-Wire Three-Bin Turning Unit 140
Garbage Can Composter 142

Incineration and Landfilling Project

5 & **6** *in the Waste Management Hierarchy*

Comparison of Waste Disposal Methods – Landfill and Waste-to-Energy ■ ◆ 143

Action

Simple Classroom Action Projects

Level
- ● Beginning
- ■ Intermediate
- ◆ Advanced

Overview

In these short action projects or classroom waste challenges, students can take immediate steps to reduce the amount of waste they generate. Each project helps students understand behaviors which create unnecessary waste in school and provides opportunities for them to reduce waste at home. Each of these projects can be initiated with little or no preparation and can be used as gateways to other ***awareness, assessment,*** *or* ***action pathways.***

Planning Considerations

1. Have students choose which immediate classroom action project(s) they want to try. Their choice should reflect the apparent waste needs of the classroom, and they should be motivated to make the project successful.
2. Another approach is to challenge students by presenting them with an unusual situation in the classroom (e.g. having them come into the room one morning and have no wastebaskets available for their trash - see Personal Trash.) Use the shock value to discuss the problem the situation presents and generate suggestions for dealing with the problem.
3. The project suggestions listed below are merely starting points. Students or teachers may have other ideas that would be just as easy to initiate and would more closely meet the specific needs of the classroom.
4. Use the awareness and motivation generated by these simple action projects to secure student commitment to more challenging action.

Action Project Suggestions

1. Collect Personal Trash

Challenge the class by removing all wastebaskets in the classroom. The goal is to minimize the waste each person produces. Because there will inevitably be some waste production, tape a small (or medium size) bag to each student's desk to collect discards for a day (or a week.) Consider cleanliness and sanitation by collecting all compostables in a separate leak proof container.

Weigh and record the amount of trash collected. This data can be used in a School Waste Audit. Discuss the reasons the waste was generated and possible ways to reduce the amount of waste the class generates. Compare the classroom waste to trash produced at home, and discuss ways for students to reduce household waste.

2. Collect Compostable Waste

Use a large plastic bucket with a cover to collect compostable food waste from snacks or other sources in the classroom. Weigh and record the amount collected daily. Brainstorm ways to reduce the amount of waste produced. Further challenge students to form a **"No Waste Club"** for snacks or lunch. Have a student volunteer take the waste home to a compost pile.

Discuss the possibility of building a classroom worm bin or compost system

for the school which might accommodate all classrooms' and the cafeteria/kitchen waste (see **Classroom Worm bin Project** and **Cafeteria Composting Project**).

3. Replace Wastebaskets

Parkinson's Law humorously states that "work expands to fill the time allotted to it." The modern corollary, **Parkinson's Law of Garbage,** states that "garbage expands to fill the space allotted to it!" If you have smaller wastebaskets in the classroom, a natural consequence may be that you will generate less waste.

Try replacing the wastebaskets in the classroom with smaller ones to force the issue of creating less waste. When students realize that there is not enough room to throw things away they will be more motivated to reduce the amount of waste they generate. Discuss ways to reduce classroom waste. Consider strategies that may help make others (students, school administration, families) aware of the amount of waste they produce and will encourage waste reduction.

4. Remove Paper Towels

Paper towels are a consumable item that adds to the classroom waste stream. Challenge students to find alternatives to using disposable paper at the classroom sink. A common solution is to provide a supply of washable hand towels that are laundered weekly by parent volunteers.

This is a clear example of the small sacrifice of convenience it takes to reduce waste from disposable products. Acceptable alternatives should not compromise health standards.

5. Use Paper on Both Sides

A common solution to reduce paper waste in classrooms is to reuse paper until all surfaces are covered. Challenge students to reduce the amount of paper that is used and discarded. Brainstorm ways to save paper and design a system to use paper more efficiently. The system might include a usable paper collection box, reusing the blank side for practice work or projects, trimming smaller usable pieces and stapling into notepads. Collect completely used paper for recycling.

6. Collect and Recycle Foam Packing "Peanuts"

Anyone who receives mail-order packages seems to get overrun with foam peanuts. Have students collect all the peanuts that come into the school, and add any that they can bring in from home. The class can reuse them at holiday time to pack and mail gifts, or take them to a local Mail Boxes, Etc. or another retail mailer to be recycled (or to be reused). The Plastic Loose-Fill Producers' Council (800-828-2214) can tell you the location and phone number of the closest peanut "recycler." Save the foam peanuts in a large trash bag and take it in to be reused whenever it's full. Large collection centers may send the peanuts to a manufacturer to be recycled into new foam. Although recycling the peanuts will help reduce waste, it may help even more if your students write to the mail-order shippers and encourage them to use biodegradable peanuts made from starch instead of the plastic ones which don't degrade.

Follow-Up

- Discuss how the challenge posed to the class changes the way they think about the problems of waste. Is it possible to generate less waste without changing our behavior?
- List the most wasteful behaviors and the areas at school that generate the most waste. How can that waste be reduced?
- Plan a waste audit for the classroom, school, or home.
- Review some more substantial action options.
- Discuss the concepts of "awareness," "assessment," and "action" with advanced students. How do they relate to one another and how are they distinct?

Action: Source Reduction

Classroom Source Reduction Campaign

Level
- ● Introductory
- ■ Intermediate
- ◆ Advanced

Overview

Students develop strategies to reduce classroom waste and to incorporate their ideas into the daily operation of the classroom.

Background

Source reduction, the attempt to decrease the amount *and the toxicity* of solid waste produced, is the highest waste management priority identified by the U.S. EPA within the *Waste Management Hierarchy*. The most efficient, inexpensive, and environmentally sound method of managing municipal solid waste is simply to avoid producing it in the first place. Waste that is never created does not need to be collected, requires no transportation, takes up no landfill space, creates no pollution, and costs nothing to handle.

See **Background Information: Source Reduction.**

Planning Considerations

1. Consider the ***assessment pathway*** **School Waste Audit.**
2. Students are likely to suggest some waste reduction strategies that may be unworkable in the classroom. With intermediate and advanced students, allow enough time to develop these ideas further into workable solutions.
3. Consider **Cafeteria Source Reduction Campaign** and **School Source Reduction Publicity Campaign**. Changing the context for source reduction will clarify the concept, and publicizing and extending the source reduction effort will clarify it further.

Suggestions for a Successful Classroom Campaign

1. Examine all the waste in the classroom trash can with the students. Allow time for discussion and keep lists as the discussion warrants.
   - Which disposable items in the trash could be replaced by durable, reusable items?
   - Which items could be eliminated altogether?
   - Which items must be thrown away?
2. Brainstorm other ways to reduce waste in the classroom. Potential areas for source reduction efforts include:
   - If the classroom has a sink, are there paper towels at the sink? Can they be replaced with cloth towels? How can the cloth towels get washed?
   - Are there some tasks for which paper is not necessary?
   - Can paper be written on more thoroughly (e.g. writing on the back)?
   - Are students taking care of their books so they can be reused?
   - Can snack foods from home be packaged more efficiently (e.g. fewer bags, fruits unwrapped)?
3. Help the students reach a consensus about what efforts should be made. Choose just a few areas in order to focus the class' efforts. If necessary, get volunteers or assign students to carry out specific tasks related to the source reduction efforts.
4. Make certain that the decisions the class makes are well publicized. Students can make posters to remind the class about the new ideas (e.g. a poster might hang above the paper supply reminding students to conserve).
5. Involve the students in overseeing and assessing the efforts. This will get each student personally invested in the project and keep it operating smoothly. Students could weight the classroom waste generated each day and graph the results on a classroom poster. Initiate discussion of what the graph shows and how the campaign is going.

Cafeteria Source Reduction Campaign

Overview

Students take steps to reduce cafeteria waste and limit the amount of trash sent to the landfill or incinerator. They generate ideas and work with food service staff and other students to incorporate new ideas into the daily operation of the cafeteria.

Level
- ● **Introductory**
- ■ **Intermediate**
- ◆ **Advanced**

Background

Source reduction, the attempt to decrease the amount *and the toxicity* of solid waste produced, is the highest waste management priority identified by the U.S. EPA within the *Waste Management Hierarchy*. The most efficient, inexpensive, and environmentally sound method of managing municipal solid waste is simply to avoid producing it in the first place. Waste that is never created does not need to be collected, requires no transportation, takes up no landfill space, creates no pollution, and costs nothing to handle.

The cafeteria and kitchen are often the largest generators of solid waste in the school community. As such they are a prime target for source reduction efforts.

See **Background Information: Source Reduction.**

Planning Considerations

1. This activity is suggested for beginning students largely because exploring the cafeteria will bring lots of new awareness about waste and their part in generating it. While they will be interested in experimenting with their own cafeteria behaviors, many of then may be unprepared to organize a school-wide waste campaign. Ideally, intermediate or advanced students would be engaged at the same time in cafeteria source-reduction, and able to take the major responsibilities.
2. Get the support of the school and food service administrators, food service staff, custodians, and other teachers before embarking on a major cafeteria source reduction campaign.
3. Any planned changes in the cafeteria will have to meet state health regulations. Be prepared to discuss these regulations with school and state officials.
4. This is a creative project! Allow students the opportunity to come up with original ideas and challenge them to follow through on their ideas. Try not to dismiss ideas too swiftly.
5. Students will need discussion time to develop ideas on how to reduce cafeteria waste, and may also need help in organizing themselves to push for changes.
6. Consider **School Source Reduction Publicity Campaign.**

Suggestions for a Successful Campaign

1. Take a tour of the cafeteria. Urge students to notice the entire process of food preparation and cafeteria waste disposal. As a class, interview the cafeteria workers about disposal and source reduction.
2. Follow-up the tour by discussing student observations. What steps can be taken to reduce cafeteria waste? Create a chart that lists possible areas for source reduction.
3. Potential areas for source reduction efforts:

● ■ **Beginning and Intermediate Levels**

- Use durable, reusable containers for bringing lunch to school instead of paper bags. Use thermoses in place of drink cans or cartons. Use reusable plastic boxes to keep sandwiches fresh instead of plastic bags.
- Drink milk without straws. Straws are not necessary and are not biodegradable. Though they seem small, they add up very quickly.
- Faculty members can drink coffee out of mugs rather than foam or paper cups if arrangements can be made to wash the mugs. What do teachers use for their coffee in the faculty room?

Action:
Source Reduction

Cafeteria Source Reduction Campaign

■ ◆ **Intermediate and Advanced Level**

- Students can investigate alternatives to disposable plastic utensils in the cafeteria. How much would it cost to purchase stainless steel utensils, to install a new dishwasher, and to hire someone to operate the dishwasher? Is this more expensive than buying plastic utensils? Which would be more expensive in the long run? What are the environmental costs of each? If it is potentially cost-effective or environmentally sound, students can propose an alternative system of providing cutlery to the school administration. This proposal will be strongest if it includes all the findings about the costs and benefits of several alternatives and proposes a specific plan to the administration.
- Students can explore the possibility of finding alternatives to milk cartons. How else could milk be provided to students? This is a crucial question, as up to two-thirds of lunchroom waste by volume is empty milk cartons! Be creative! Present options to the dairy which supplies milk to the school.

4. Help the students reach a consensus about what efforts should be made. Choose just a few areas to focus the class' efforts. If necessary, get volunteers or assign students to carry out specific tasks related to the source reduction efforts.
5. Help students think hard about publicity (develop a theme, post very specific signs). The success of the campaign may well turn on the effectiveness of the students' communication with the rest of the school.
6. Involve students in the supervision of the project. This will help keep the project running smoothly and it will keep students invested in the program.

Follow-Up

It is important to assess the outcome of the source reduction efforts. Discuss how the success of the program can be monitored. Has waste been reduced in the cafeteria? How much?

Potential methods of assessing source reduction efforts:

- Develop a survey to be given to schoolmates. The survey can ask students if they have changed their behavior as a result of the source reduction campaign.
- Weigh the cafeteria wastes before and after the campaign. Did the source reduction campaign correlate with a decrease in waste?
- Count the number of straws that are taken from the dispensers before and after the campaign.
- Interview the cafeteria staff. Did they notice a decrease in waste? Have they purchased less? Have they saved money? How much?
- A class discussion about the project can be invaluable. Did students in the class become more aware of what they throw away in the lunchroom? More important, did they reduce their personal waste?

Related Pathways

1. What other communities that students belong to might benefit from source reduction campaigns? How could students encourage source reduction in communities they do not belong to?
2. Looking back on their cafeteria source reduction campaign may provide advanced students with a priceless opportunity to examine group and organizational behavior. How are decisions made in schools? in other institutions? What happens when values conflict? How does change occur in an organization?

   Such a discussion might be combined with an assessment of the strategies and tactics that had been employed by the class: which were the most effective? least effective?
3. Consider **Cafeteria Composting Project.**

School Source Reduction Publicity Campaign

Overview

Students plan ways to reduce waste throughout the school and to publicize their ideas to the entire student body.

Level
- ● **Introductory**
- ■ **Intermediate**
- ◆ **Advanced**

Background

Source reduction can help shrink the waste stream dramatically with very little work or investment. People simply need to examine their habits, then find ways to change wasteful behavior. Most people want to do the "right thing" but often need a push. This project will help provide that little push!

See **Background Information: Source Reduction.** Consider **Classroom Source Reduction Campaign** and **Cafeteria Source Reduction Campaign.**

Planning Considerations

1. The focus here is on publicity, and how it can be used to gain support for an idea such as source reduction (see **Appendices/ Tools for Action: Publicity**).
2. This pathway can be seen as extending the kinds of thinking and action that have engaged students in **Classroom Source Reduction Campaign** and **Cafeteria Source Reduction Campaign.** Or it might be seen as a general introduction to source reduction, with the **Classroom** and **Cafeteria** projects to follow. Consider involving advanced students in discussing the advantages and disadvantages of each option.
3. Students will need help generating ideas, setting priorities, and organizing themselves to effect a successful publicity campaign.

Suggestions for a Successful Campaign

Developing Ideas and Priorities

1. Begin a class discussion by examining all the waste in the classroom trash can.
   - Which disposable items in the trash could have been replaced by reusable items?
   - Which items could be eliminated altogether?
   - Which items must be thrown away?
2. Construct a list of wasteful behaviors in the classroom.
3. Discuss three or four specific ways that waste could be decreased in your own and in most other classrooms. (See **Classroom Source Reduction Campaign.**)
4. Consider the cafeteria. Where could waste be reduced in the cafeteria? (See **Cafeteria Source Reduction Campaign.**)
5. Be sure the discussion touches on other parts of the school, including the library, the office, the faculty lounge, and the art room. (Consider **Unsolicited Mail** and **Promoting Alternatives to Hazardous Products**). How could waste be reduced in each of these places? A walking tour of the specific areas may be very helpful in generating good ideas for waste reduction.
6. Urge students to discuss the ways in which individual awareness can help to reduce waste. For example, getting students in the school to be conscious of the amount of paper they use may be enough to make some significant progress in diminishing waste.
7. Discuss the ideas that have been generated and try to come to a consensus about which ideas are the most interesting for a publicity campaign. When the issues to address have been determined, turn the class attention to the publicity campaign.

Publicity Campaign

1. Decide on a theme for the publicity campaign so that students in the school identify the project as a whole.
2. Call a publicity planning meeting. How will the message about source reduction get out to the school? Some obvious methods come to mind, including posters and school announcements. Others might include a school assembly, a play, poems on the walls, artwork. Several media will help provide variety and reach more students.
3. Divide the class into small groups to work on the various facets of the publicity campaign. Be sure that there's a group working on assessment of the campaign. How will this be done? Should some information be collected before the campaign begins?

Related Pathways

1. Consider attempts to reach a wider audience, like broadcasting a public service announcement, arranging for a newspaper article, or preparing a link to the school district's web page. For some help see **Appendices/Tools for Action.**

Unsolicited Mail: "Who's In Charge Here?"

Level
- ● **Beginning**
- ■ **Intermediate**
- ◆ **Advanced**

Overview

Students will analyze types and sources of mail, determine which mail is unwanted by whom, and review action options available to them if they are to eliminate the unwanted mail. Intermediate and advanced students may be challenged to manage competing values, to understand diversity within the community, and to distinguish between public and private goals.

Background

People in the United States who sell products or support causes, whether television sets or hairspray or candidates for office or environmental protection, have found *direct marketing* highly effective. In addition to advertising on television or on billboards, companies deliver appeals directly to individuals or households. Newspapers and magazines are packed with inserts and pullouts; handbills are placed beneath the windshield wipers of our cars; answering the phone in the evening, we often find ourselves talking to strangers with something to sell.

By far the most direct marketing, however, travels by U.S. Postal Service *bulk mail.* Various categories of bulk mail offer low postal rates to organizations willing to send enough pieces of mail, and "presort" the pieces. Occasionally we ask a company to put our address on a list for catalogues or other promotional material, but most of these mailings are *unsolicited.*

Even though we may have originally purchased a product or requested a catalogue the number or frequency of mailings we receive is generally out of our control.

Without a single request, an American family can receive as many as three hundred catalogues, or 100 letters inviting them to apply for a credit card, in a year. Mailers look for effective ways to build their mailing lists, often taking advantage of mail-in warranty cards, contests, merchandise offers, and surveys. Marketers, fundraisers, and publishers are often engaged full-time in building and sorting computerized mailing lists and selling lists to thousands of advertisers. Many government agencies also have lists for sale. The Postal Service provides change of address service to mailers requesting address corrections. The Postal Service also offers rates at which mailers may blanket a certain geographical area with mail addressed only to a "Postal Customer," or direct letters to the "occupants" at certain mailing addresses.

Because of unsolicited mail much merchandise is sold and advertised, many worthy charitable and non-profit causes are financed, and much useful information is distributed. Many enterprises and jobs are supported. According to the Direct Marketing Association, 132 million American adults (67%) ordered merchandise by mail or phone in 1995. The Postal Service has done a survey that shows that this saves millions of gallons of gasoline.

Because of advertising mail (solicited and unsolicited) many natural resources are also consumed. According to the Stop Junk Mail Association, there were 62 million trees cut, and 25 billion gallons of water used for the production of "promotional mail paper" in 1992. Some unsolicited mail is of interest to the recipient, of course, and some is not. Plainly, though, much of it is delivered and then immediately thrown in the trash. The Postal Service has determined by its annual Household Diary Study that approximately 15% of direct mail is discarded without

being read. Mail that is *unsolicited and unwanted* has become known as "junk mail."

In October, 1998, the Postal Service released the recommendations of the National Task Force on Greening the Mail in an effort to address a number of environmental issues related to the mail. The task force identified 3 major objectives (encourage waste prevention=*reduce*, improve recyclability of the mail=*recycle*, and increase recycled content in mailings=*reuse*), and 11 specific goals to achieve "greening" of the mail. Notable among the goals for reducing waste are promoting the use of less material in mailings, encouraging mailers to target mailings more effectively, and encouraging mailers to provide respondents with the choice to opt out of future mailings or to receive only specific, limited mailings. The group identified a number of problems with recycling the mail, including the use of non-fiber materials. Non-water soluble glues on "sticky" notes and other materials that travel through the mail may foul up the paper-making process, and the task force urges that research in more benign adhesives move ahead quickly. Finally, the group identified important goals for promoting increased recycled content in materials used in mailing.

Citizen efforts to reduce the flow of unsolicited mail are often motivated by a desire to conserve resources, but are also often tied to a desire to preserve privacy rights. Many people feel it is a violation of privacy to have mailing addresses (or their phone numbers, their buying habits, or other personal preferences) sold or given away without permission.

Some postal customers are perfectly satisfied to accept whatever unsolicited mail comes to their door. Others, out of concern for conservation or privacy, attempt to take charge of their mailbox by taking advantage of *many tools that are available* to eliminate unwanted mail. Many others are not aware that these tools exist (or that many of them are made available by direct marketers themselves, who benefit when they avoid sending mail where it is unwanted). Still others are concerned enough about the negative environmental effects of unsolicited mail that they urge the community to take charge through legislation.

Building Further Awareness

1. Consider **School Waste Audit** and **Home Waste Audit**. Have students and their families inventory the unsolicited mail that arrives at home for a two-week period before the project begins, and save the unwanted portion. What percentage of the unsolicited mail was unwanted? By weight? By volume?
2. Look into the papermaking process at an appropriate level. Contact the high school chemistry teacher, papermaking organizations, or environmental groups for help. Go to *www.beloit.com/site2/about/industry* for industry links and to *www.edf/pubs/reports/ptf* for the view of the Environmental Defense Fund.
3. ● ■ Ask a few parents to bring in their unsolicited mail, and invite them and the local postmaster to join the class in a bit of sorting and discussion. Possible issues:
   -Classes of mail. Is there unsolicited mail in all classes?
   -Who sends unsolicited mail and why?
   -How much unsolicited mail did the school receive in two weeks? How much of it was used?
   -What can you do with unwanted mail?
4. Go to *www.the-dma.org* (the Direct Marketing Association), *www.obviously.com/junkmail* (the Obvious Implementations Corporation), and *www.usps.gov/fyi/welcome* (the U.S. Postal Service Enviromental section) and other sites, for statistics and points of view on unsolicited mail. Visit the local Postmaster about Post Office recycling, and about the National Change of Address Program, which updates the mailing lists of bulk mailers for a fee.
5. Sorting mail with these students can give rise to classification and charting exercises. Have students bring in, along with the family's unwanted, unsolicited mail,

the family's *wanted, unsolicited mail.* Discussion questions might include:

-How does the family's percentage of unopened mail compare with the national average of 15% determined by the Postal Service's Household Diary Survey?
-How does unsolicited mail differ from family to family?
-What things about families make their definitions of mail differ?
-What other materials, besides paper, are mailed out unsolicited?

As students attempt to clarify the issues involved in "taking charge," discussion might move to questions such as these:

-How do mailers get your address?
-What are some of the reasons direct marketing has grown in recent years? Does it conserve any resources?
-Is it a more efficient use of resources than advertising in newspaper, or on television or radio?
-Why is "privacy" important? Why are we said to have a "right to privacy?"

Choosing Course of Action

1. ● This is seen as a short and simple ***awareness pathway*** in elementary classrooms. But perhaps young students will go into action under the guidance of their families. Provide a sheet describing various tools (below) they could use to reduce advertising mail, and suggest family discussion.
2. ■ ◆ Some families may wish to attempt to eliminate *all* unsolicited mail. They may be concerned enough about natural resources conservation, privacy, or just with clutter or the use of time, to do without that portion of their unsolicited mail which is of no interest or use. Families who wish to have their name and address removed from *all nationwide* bulk mailing lists may make this request of the *Mail Preference Service* (see **Appendix III: Organizations**). More comprehensive and prompt action can be expected from the *Stop Junk Mail Association* (see **Appendix III: Organizations**), which contacts all the major direct-mail services on behalf of its paid members, and provides the members a kit full of ready-to-mail postcards and further suggestions. Within two months the family should see significant reduction in unsolicited mail, and can work on piecemeal fashion. To remain "in charge," be sure that your *wanted* correspondents are not sharing your name with others: Boldly write "*Please do not sell or share my name or address,*" whenever you are donating money, ordering a product or service, or filling out a warranty card or survey.
3. ■ ◆ Have students whose families wish to eliminate *unwanted* mail collect their unwanted mail for another two weeks and bring it to school, along with a note from parents indicating that the collection is indeed unwanted. Divide the mail into three categories: 1) Mail that has a toll-free telephone number, 2) Mail that has a prepaid return envelope, and 3) All other mail.

   Students should call the toll-free numbers in turn, having in front of them the mailing label from the appropriate piece of mail. Politely request that the name and address on the label be removed from the mailing list and not distributed to other mailers. Explain why you are taking this action. Use school phones where you can, and make other calls from homes.

   Then, draft a standard letter to mailers. Somewhere on the page should be a place to tape a mailing label. Direct the recipient organization politely but firmly to remove the name and address on the label from its mailing list, and not to distribute it to any other mailer, and explain why the action is being taken. Spend some time as a group finding the best way to organize and pay for the task of preparing letters with inside addresses, taped-on labels, envelopes, and postage stamps (outside of the credit card companies, there will be few postage-paid envelopes in advertising mail).
4. Keep careful record of all the requests that are made by mail and by phone, and watch for results.

5. ◆ Consider the option of "public," as well as "private" action, and look clearly at distinctions between the two: Perhaps the most important distinction is that private action (such as eliminating your family's unwanted mail) imposes (significant) consequences only on those taking action, while the person taking public action assumes responsibility for consequences borne by others as well. Another distinction involves "justification." What is "justification?" Why might pursuit of a public goal call for a different sort of justification than pursuit of a private goal? Discuss possible forms of public action that could be taken in connection with unsolicited mail.

   -Would a "catalogue exchange" effectively reduce the flow of unsolicited mail into the community? What goals might be achieved by the sharing of subscriptions to periodicals?

   -How can information be made more widely available about tools for eliminating unwanted mail? How can people be encourages to use them?

   -Contact government agencies to evaluate and attempt to influence their policies concerning the distribution of mailing lists.

   -Contact the local Postmaster about Post Office recycling of unwanted mail. Can mail saved at home be delivered to the Post Office for recycling? Does your local Post Office have a recyling bin in the lobby? Why or why not?

   -Does the local recycling center accept "mixed paper?" Why or why not?

   -Should the community further regulate the flow of unsolicited mail through legislation?

Suggestions for Successful Action

1. This pathway provides great opportunities for school-family cooperation. Be sure that parents know the reasons why unsolicited mail is being audited and saved, and that they are involved in selecting the "unwanted" portion of mail. Many of the tools students will learn about on this pathway will be new to parents as well.
2. Undertake this project early in the year. It takes time for mailers to make the mailing list changes which will demonstrate the results for this project.
3. Be sure all the mail collected is reused or recycled.
4. If two mailing labels are not identical, changes should be requested for each.
5. Be sure the teachers' room mail and the school office mail are audited, and a decision made about taking charge of the bulk mail stream. This will quicken student interest.

Assessment and Followup

1. Two or three months after letters and phone calls have been made, conduct another audit at home and school. Has action achieved the intended consequences? Unintended consequences?
2. For mailers who have not heeded requests, perhaps a slightly more forceful letter or call is in order.
3. Work on "public messages" stemming from this ***pathway***. Keep the local Postmaster informed of unwanted mail audit results and other reports of class work. Ask the local newspaper to publish the students' message about unsolicited mail and tools for taking charge.
4. Let us know at Chewonki about your efforts. What advice do you have for other classes?

Promoting Alternatives to Hazardous Products

Overview

Level
■ *Intermediate*

*From **Test the Alternatives** students have learned the recipes for household cleaners which can serve as alternatives to toxic commercial products. From other pathways they have learned about the hazards of some batteries, glues, and pesticides. Here, students generate strategies for informing the general public about the dangers of household products, and for promoting the use of alternatives. Small groups conceive and produce a flyer for students and parents, a skit for the school variety show, or a set of posters to display in their neighborhoods.*

Background

Consider **Test the Alternatives, Everyday Choices,** and **Getting to the Route of the Hazardous Waste Problem,** before taking the turn onto this ***action pathway.***
Also, see **Background Information: Household Hazardous Wastes.**
Whenever hazardous wastes are the topic, students should be reminded that–because of the immediate danger they pose to the environment–they are handled with special caution and are governed by special regulations. However, the *Waste Management Hierarchy*–by which sources reduction, reuse, and recycling are preferred–applies to hazardous wastes as well.

Planning Considerations

1. Enlist the support of experts on art, word processing, chemistry, consumer skills, etc. on the school staff or among parents.
2. Consult with the principal, food service, and custodial staff about the possibility of using alternative cleaning products in the school. They may help students test the alternative products, or review their projects.
3. Consider **Home Hazardous Waste Audit** to help pinpoint problem areas in homes. Generally, use the ***assessment pathways*** to set priorities for student projects.

Suggestions for a Successful Promotion Project

1. Brainstorm possible small group activities for this project. Possibilities include an informational poster campaign for the school, a brochure for parents and students, a public display for the mall or a grocery store, a video or print advertisement, or a link to the school or community website.
2. In the small groups, have students define their project, divide research responsibilities, research the topics, and make an outline for the project.
3. Before making the promotional material available to the people they are attempting to influence, the groups should set up a method of evaluating the success of their promotion.
4. Don't forget those thank-you notes to staff and parents who were helpful!

Follow-Up

- Send an article to the local newspaper with samples of the projects. Ask the editor to print projects in an article or as a supplement.
- Check with users of the products after a month to see how effective they are and if they are still using them.

Action: Reuse

Paper Reuse Campaign

Level
- ● Introductory
- ■ Intermediate
- ◆ Advanced

Project Length
2 class periods

Overview

Students identify sources of paper waste in the classroom, office, and teacher's room; then they develop strategies to reuse usable paper.

Background

Paper is usually one of the largest budget items for "consumable" materials. While there are many school activities that require paper, a great deal of paper often gets wasted. By reusing paper with useful surfaces, and by using it for other purposes, the school will save money as well as reduce solid waste.

See **Background Information: Reuse.**

Planning Considerations

1. Get budget figures from the principal to document how much paper is purchased each year. Have students calculate the average paper use for each classroom; each student.
2. The focus of this action project is on *reuse*, but you will find that there is a lot of paper that can't be reused, but could be recycled. You may want to combine this project with a paper recycling program (see **School Recycling Program**).

Suggestions for a Successful Campaign

1. Inventory the amount of paper thrown away in the classroom, office, teacher's room, and other locations where paper is used or copied. Include all types of paper besides books (worksheets, handouts, notebook paper, drawing paper, newspapers , magazines, tests. Separate out the paper that could be more completely used in some way before being thrown out. How much money could be saved by reusing that paper? Set a goal for how much paper can be saved (by your class; by the office; etc.) for the rest of the school year.
2. Brainstorm with students to generate ideas about how paper can be reused. Their ideas will most likely include: making double sided copies, using the backs of paper for drawings or practice work, making note pads from partially used paper.
3. Discuss ways to inform others in the school about saving reusable paper and how they can use paper more completely. Prepare "publicity" (Don't Crumple! Separate!)
5. Set up collection boxes in the various locations so you can collect the paper separately from other trash. You might leave notices about which types of paper you want to collect for reuse. Other bins might be set up at the same time for paper recycling.
6. Be sure there is a process in place for seeing to it that the reusable paper that is collected gets reused. Consider how this reuse campaign might become a permanent routine.

Follow-Up

- Calculate the amount of paper saved, and the value of that paper.
- Propose that the money saved by not buying paper be transferred in the budget to other student-related projects or to a student/faculty controlled fund. (The Windham, Maine Jr. High School Student Environment Committee takes revenues from their recycling program and administers a mini-grant program for teacher projects.)

Related Pathways

1. Discuss ways to persuade school administrators to purchase recycled paper or paper with higher post-consumable content (see **"Buy Recycled" Campaign**). Money saved by reusing paper might be applied to the slightly higher cost of some recycled papers.

Used Clothing Swap

Overview

Students and their families collect clothing that is no longer useful to them and 1) make it available to other families at a yard sale-type "swap" and 2) give the leftover items to a local charity for use or sale. This is an effective one-time event or can develop into an annual tradition.

Level
- ● *Introductory*
- ■ *Intermediate*
- ◆ *Advanced*

Background

Textiles comprised 1.7% (by weight) of Municipal Solid Waste in Maine in 1991. Although this seems like a very small amount, 1.7% represents 21,250 tons of cloth! This figure does not include industrial textile waste or non-baggable cloth in MSW. Used cloth is collected and processed by the Salvation Army and Goodwill Industries as well as many thrift stores and second hand stores. Clothing that is too worn out is cut into rags by the big processors and sold as rags.

See **Background Information: Reuse.**

Planning Considerations

1. This project will have the biggest impact if families from the entire school participate (although a single class can collect a significant volume.) It is energy intensive and parent volunteers will be very helpful, although intermediate and advanced students can do a lot of the work. If a smaller event is planned, the swap can be held during or after school in a less formal way.
2. Publicity and organization will be the biggest factors for success. Give enough notice so families can go through closets to collect items to donate to the clothes drive.
3. Make provisions for collection and storage of the items before the "swap." Ask to have "swappable" clothing marked for size and separated from rag material.
4. While preserving the emphasis on swapping, consider using money as a medium of exchange. In order to collect items in advance and display them by size or type, it will be necessary to give families contributing items a certificate worth a certain amount of "money" at the "swap." Such certificates would be redeemable only for clothing, and not for money. However, there is no reason why families who do not have clothing items to contribute could not use money to purchase clothing.
5. Contact local charities to get a commitment to accept all clothing left over from the swap.
6. Consider other items to be collected and swapped. For example, toys can be cleaned and traded. Games and books can be donated to local hospitals and libraries.

Suggestions for a Successful Drive

1. Have the class decide how large a project they want to take on (the class, the grade, the school.)
2. Generate ideas for:
   - informing families and other students about collection and the swap
   - creating publicity
   - date and location of swap
   - managing materials collected
3. Divide responsibilities for publicity, collection, storage, sorting, transport of materials. Enlist parents when necessary.
4. On the day of the swap the ease with which families can find garments of the size and types they need will make all the difference! Spend time on this aspect.
5. Keep a good tally of what is "swapped" and what is left over. You want to know the impact of the event, and you want to have information to use in follow-up.

Follow-Up

- Make and display a chart from the data to inform the school about the success of the project.
- Write a short report describing the project and send it to the Chewonki Foundation.
- Write an article for the local newspaper describing the project and the results.
- Write letters of thanks to all volunteers who helped with the project.

Action: Reuse

Magazine Reuse Campaign

Level
- ● Introductory
- ■ Intermediate
- ◆ Advanced

Overview

Students develop a system to collect and redistribute magazines to friends, laundromats, waiting rooms, and other public places where they can be read by other children and adults.

Background

Anyone who subscribes to a magazine quickly learns how fast old magazines accumulate. Many of these magazines can be donated and reused. Business owners or families who know a regular supply of not-too-outdated magazines is available may be able to cancel a subscription and save natural resources.

Planning Considerations

1. Inform parents about the project and ask for their help in delivering magazines on a regular basis to one or two locations each.
2. Consider donating magazines to a Laundromat, any health care or other office waiting room, hospital, school home economics or child care classroom, public library (perhaps the library would be interested in sponsoring the campaign in some way). Students may find they can share magazines among themselves.
3. Consider extending your efforts to recycling worn and unneeded magazines at the same time.

Suggestions for a Successful Campaign

1. Survey the class (and the school) to create a list of magazines that might be available for donation.
2. Students will be interested to find out what magazines their friends have, and to arrange swaps among themselves. In most cases this will be the extent of a magazine reuse campaign for beginners, although students might become delivery persons for swaps among their parents.
3. Compose a letter of request with a response form, and distribute it to all the possible sources of magazines. Keep track of the responses in a list or in a simple computer database.
4. Begin collecting the magazines right away. Store them in boxes by magazine-type.
5. Brainstorm a list of public places where magazines could be enjoyed by people who need to wait, or who could benefit from any particular type of magazine.
6. Divide responsibilities for contacting those places to see 1) if they are interested in receiving magazines and 2) which magazines (of the ones you will have available) they would like to have.
7. Match the magazines available to the types requested and begin delivering as soon as possible.
8. Establish a schedule for regular collection and delivery of the magazines. Give students as much responsibility for this process as possible.

Follow-Up

- Maintain the magazine collection schedule and check with the students, their parents, and delivery locations regularly to provide support.
- Write an article for the local newspaper describing the project. Have a recipient of the magazines write a letter to the editor.
- Organize a magazine recycling collection program at the school and transport unneeded magazines to the recycling center.

Trash-to-Art Festival

Overview

This is a class- or school-wide activity where students gather materials that are being thrown away to create unique "art" projects. With few rules or limitations, students are asked to gather materials and do the construction at home, then bring their creations to school for a festival to be displayed. Prizes are awarded.

Level
- ● Introductory
- ■ Intermediate

Background

Many household throw-aways are reusable:

- glass jars to store food and small items
- paper and plastic bags for storage and shopping
- washable plastic dinnerware
- plastic containers for storing leftovers and for freezing foods
- washable aluminum pie tins
- polystyrene packing peanuts for mailing your own packages

However, there are items that eventually must be discarded. This activity is a final attempt to make "valuable" use of some of those items. Possibilities for trash-to-art projects include collage, masks from plastic jugs, flower post, bird feeders, sculptures, robots, or 3-D models. The list is limited only by students' imagination!

See: **Background Information: Reuse.**

Planning Considerations

1. Items of "trash" must be clean.
2. Ask school administrators and community leaders to be judges.
3. Give students enough time to complete the projects at home, but not too long. One or two weeks is a reasonable time frame and avoids having projects create clutter.
4. Younger students or special groups may benefit from constructing projects in-school.
5. Arrange for the dismantling and recycling of as many of the components as possible. Students should plan to take their projects home if they can't be recycled. It would be counter-productive if the projects were left at school for the custodian to throw in the dumpster!
6. Communicate with parents about the projects so they can get involved. Send home information about recyclables, reusables, and waste reduction to get the families involved with waste reduction.

Suggestions for a Successful Festival

1. The basic rule: Each project must use only items that would be thrown out. You might bend this rule by saying that glue or other "non-trash" fasteners are acceptable. Projects can be two-dimensional (like a painting or collage) or three-dimensional "sculptures" or models. They should be stable enough to be transported to school.
2. Provide a few examples to get the students motivated. A lead class could make a few items in school from school trash (like milk cartons!) to spark the imagination of other students.
3. Have students work in pairs or small teams. Some students may choose to work independently.
4. Have students describe their progress (progress reports or drawings) part way through. They may be able to share ideas or encourage those who are having a hard time.
5. Establish categories upon which the projects will be judged: Creativity, most recyclable, best working model, neatest, etc. There can be any number of fun or made-up categories to include as many winners as you like!
6. On the day of the festival, include other displays to teach about waste reduction, reuse, or recycling. Have students bring in redeemable cans and bottles as a fund-raiser.
7. Have the operator of your transfer station or a waste hauler present the awards.

Follow-Up

- Brainstorm ways to dismantle or recycle the projects.
- Use the enthusiasm from the festival to kick off other action projects or fundraising activities.
- Be sure that photographs of some of the most popular creations (and their creators!) appear in local newspapers.

Action:
Reuse

Waste Paint Exchange Project

Level

■ *Intermediate*

◆ *Advanced*

Overview

In considering a waste paint exchange for their families and the community, students directly confront issues of safety, liability, and legality. They research the hazards of paint and strategies to deal with waste paint. They contact potential donors and potential users of leftover paints, and promote participation in the exchange.

Background

The average American family has about four gallons of old paint stored in the basement or garage. It is estimated that unused paint accounts for 50-80% of the hazardous waste dumped by households. Old paint that is dumped or disposed of improperly can pose a serious threat to human health and the natural environment. Solvent-based (alkyd or oil-based) paints have more hazardous components than water-based (latex) paints. Yet, latex paints manufactured before 1991 may contain significant quantities of mercury, and any very old paint is likely to contain lead.

There are few alternatives for properly disposing of old paint. Household hazardous waste collection programs are rare because they are very costly to communities. Although some experts condone the disposal of an occasional can of paint if it is mixed with significant amounts of sand, sawdust, kitty-litter, or other absorbent material, paint should generally not be placed in landfills or incinerators because of potential for contamination. However, empty paint cans and lids can be recycled along with other steel or tin cans. They do not have to be scrubbed clean, but should be empty. A thin skin of dried latex paint may be left on the bottom and sides of the can. Cans with small amounts of latex paint can be left open outside (away from people or pets) and allowed to dry. The dried paint should then be discarded with the trash and the can recycled.

Paint that cannot be used or given away should be clearly marked and stored with a tight lid until a collection program is available.

Source reduction is the best way to avoid the disposal dilemma: Only buy as much paint as you need for the job. Using paint completely is the next best choice: Paint another coat, or offer to paint a neighbor's dog house.

Reuse is another option. With large amounts of paint of various types and colors being used all around us, why not collect the leftover paint we have no use for and put it in the hands of households or organizations who have a use for it? Small amounts of leftover paint could also be combined to make enough for a gray or brown undercoating job.

Such a waste-paint exchange must be approached with caution. Dangers associated with highly flammable solvents and toxic heavy metals are multiplied as quantities are increased. However, the prospect of finding a use for a significant amount of hazardous material from the waste stream–material for which there are no good disposal options–prompts us to pursue the idea of a waste-paint exchange, which also has the potential to raise community awarness of problems associated with paint.

References

1. See **Background Information: Household Hazardous Waste.**
2. *Arrange a meeting with appropriate school system officials and a representative of the agency which regulates hazardous material in your State. Discuss safety and liability issues that may reside in the course of action you and your students are considering. Involve at least one student, who can help you with a thorough report to the others.*

Choosing a Course of Action:

Based in part upon your consultation with the school system and regulatory officials, consider available options:

1. An "on-paper" waste paint exchange in which students and teachers do not take possession of waste paint: Students brainstorm and investigate possible uses for leftover paint (Could a local manufacturer use a large amount of paint to protect a storage building? Does Habitat for Humanity have any projects nearby?), contact potential paint donors to see what amounts and types of paint are available, and potential paint users to secure equivalent information about needs. Donors are then put in touch with users, and exchanges made at their convenience.
2. Recruiting knowledgeable parents and other adults to *do all the direct handling* of leftover paint at an exchange which occurs at a certain time and place, allowing for collection, display, and mixing of paints. This option will allow more households and groups to become involved both as donors and users; the opportunity for close examination of the paint will increase the likelihood of productive exchange. The fellowship, educational value, and publicity value, of an actual *event* make this option attractive. An obstacle to the feasibility of this option, however, is the possibility that, because needs are not identified in advance of donations, there could be a large amount of waste paint left at the end of the exchange. Be sure that you have arranged to have donors take back their unclaimed paint, or that some other safe and legal destination has been arranged.
3. Recruit knowledgeable parents to *directly supervise* students handling paint at such an event. Perhaps safety and liability concerns can be allayed by the setting of strict rules about the handling of the paint.

Suggestions for a Safe and Successful Exchange

1. Plan the exchange for a time in the spring or fall when people are doing house and yard clean-up projects.
2. In most states, painting contractors could not be involved in the exchange as donors, because they are required to dispose of their waste under regulation as "small quantity generators." In many states painting contractors could be recipients of waste paint, as long as they could certify to regulators that the paint would be used in one year. Raise this and related issues in your meeting with state regulatory officials.
3. The school system and regualtory officials with whom you are consulting may be able to help students draw up simple forms by which donors would certify their intention to use the waste paint in the near future. (Be sure that students or their parents are not so eager to participate in the exchange that they take home paints that they are not going to use!)
4. Also ask state regulators or other experts for help with a plan for dealing with the possibility that paint will be spilled during the exchange.
5. The success of the exchange will depend largely upon the quality of the publicity surrounding it. Get students involved in the preparation of a clear description of the exchange to be used as the basis for all posters, releases, and discussions with community groups. Publicize the event widely, and invite coverage by local media. Have handouts ready which discuss hazards associated with various types of paint and various waste management options.

Action: Recycling

School Recycling Program

Level
- ● **Introductory**
- ■ **Intermediate**
- ◆ **Advanced**

Overview

*Awareness and **assessment pathways** provide a solid footing for setting up a recycling program at your school. Energy must be maintained over a long term, but there are many options.*

Any materials that are accepted for recycling by your hauler or local recycling center can be included in the program. Depending on the scope of your program, you could separate and recycle only one or several different materials (office paper, newspaper, aluminum, glass, steel or tin cans, magazines, plastic, and/or redeemable cans and bottles.) You might even earn some money to help support the program by selling materials directly to brokers.

Background

Remember that recycling is the third priority on the waste management hierarchy. Source reduction and reuse strategies should be developed in addition to collecting materials for recycling. However, by establishing a recycling program in school, students and teachers become more sensitive to creating less waste and conserving resources.

References

Go to www.obviously.com/recycle for starters. Contact local and state waste management agencies for pamphlets and tips. A good list of recycling contacts in each state is found at www.epa.gov/grtlakes/seahome/housewaste/src/states.htm.

Planning Considerations

1. The school-wide recycling program is a major undertaking and will need the support of students, teachers, school administrators, food service personnel, custodians, waste haulers, the recycling center staff, and/or brokers. A faculty advisor should be identified to provide continuity between all segments of the program.
2. Consider **Local Waste Management Options.** Here is where you will identify local recycling facilities, haulers, brokers, and markets. Will you accept materials from beyond the school? How will that effect your space and equipment needs? Will you sell directly to brokers? How will that effect your relationship with your hauler and local recycling center? It is important to work at keeping these relationships healthy. School recycling programs often establish separate markets only for those materials which are not accepted by their hauler or local recycling center.
3. Establish the lead class, a recycling committee, or an environmental club with a faculty advisor to help coordinate the recycling program and to promote it throughout the year. This is one of those activities where Beginners will only be able to participate significantly if there is interage cooperation. If Beginners and Intermediates are in the same school, or if Intermediate or Advanced students can somehow travel to the Beginners' school on a regular basis, there is potential for a very productive partnership.
4. It is often better to start out small by collecting only one or two materials. Expand the program later, when procedures are running smoothly and participants are familiar with the program.
5. Create a budget for the program. Consider expenses like collection bins and hauling fees. Research possible revenue from selling recyclables or cost savings from reduced disposal fees.
6. Consider **School Waste Audit** for information about the volumes and types of materials you can anticipate.

Suggestions for a Successful Program

1. Have the recycling committee decide on the scope of the program. Consider starting with paper, especially if it is the recyclable item with the largest volume in your waste stream.
2. Divide responsibilities for any necessary research. Think through the mechanics of collecting and recycling the materials.

Find a market

3. Who will take your recyclables? Find out if your current waste hauler offers recycling services. Is there a separate broker that will accept your materials? What does the local recycling program accept? Decide which is the most convenient and lowest cost option.
4. Determine how the materials must be gathered and prepared for the recycler or broker. Exactly what is acceptable (what types of material, crushed or not crushed, bundled or not, etc.) and what is the minimum amount required for a load?
5. How will the material be delivered to the processor? What are the delivery costs?

Determine space, container, and equipment needs

6. How will you store the material? How much will need to be stored between pick-ups? Do new facilities need to be built? Where? How? Is there a no-cost solution?
7. Will the recycler provide containers? Will you need to make containers yourself? The collection bins should be
   - the same throughout the school,
   - colorful and different from regular trash containers,
   - clearly marked for the type of material being collected.
8. Storage areas should be convenient and clearly marked for pick-up. They must comply with safety codes.

Educate participants and promote the program.

9. Provide clear, accurate information. Plan the educational campaign so people will know
   - what you want them to do,
   - how you want them to do it,
   - what they will accomplish by doing it.
10. Prepare promotional and informational materials. Develop ideas with the students which may include notices, a poster contest, in-class demonstrations. Have students teach students and make the presentations when possible.
11. Present a skit or other formal kick-off event for the whole school

Plan for on-going maintenance of the program.

12. With the recycling committee and other interested students, create a work schedule that divides responsibilities over time so enthusiasm can be maintained.
13. Monitor proper use of the containers, oversee on-going promotion, provide feedback to encourage participants.

Follow-Up

- Evaluate the program. Keep careful records of the program's effectiveness. How much are you recycling? Does this match your expectations? Make suggestions to the committee.
- Have local media cover the success of the project. Get as much publicity as possible. Continue to promote the program using the data gathered.
- At the end of the year plan a ceremony to transfer responsibility for managing the recycling program to an upcoming grade.
- Recruit new members for the recycling committee and plan on recharging the program each fall by *re*starting the committee, *re*teaching participants, and promoting the program with new energy.

Action: Recycling

"Buy Recycled" Campaign

Level
- ● Introductory
- ■ Intermediate

Overview

Students initiate an awareness campaign to encourage school officials to buy products with recycled content for use in the school. They also identify products with recycled content and retail sources of these products, then encourage their families and the community to buy recycled content products rather than products without recycled content.

Background

The national "buy recycled" campaign encourages the procurement–especially by businesses, nonprofits, and government agencies–of products with recycled content. The program is designed to promote markets for recycled products and ultimately to help change consumer habits, so that recycling can become a self-sustaining enterprise. Yet, there is much work that needs to be done to educate consumers, retailers, and manufacturers about the essential elements of recycling.

The recycling logo contains three chasing arrows. Each arrow represents an element of the recycling process:

1. **Collecting** materials that otherwise would be thrown away,
2. **Manufacturing** new products using those materials, and
3. **Purchasing** the new products.

Recycling is not complete until the materials collected are turned into new products and those products are then purchased again by consumers. All three steps are necessary to "close the loop." For recycling to succeed, consumers must buy recycled content products and let the retailers and manufacturers know that they want products with recycled content. In addition, schools have significant buying power and can influence markets by "buying recycled."

Consumers should understand the meaning of the terms used in recycling so they can make informed purchasing decisions:

- **Recycled** refers to a product which contains *some* recovered materials.
- **Recovered materials** include both preconsumer and postconsumer materials.
- **Postconsumer materials** come only from products which have served their intended end uses; they are materials that have been collected in office, commercial, and residential recycling programs; otherwise they would have been discarded in the waste stream.
- **Preconsumer material** refers to any material generated in the manufacturing process. This does not include any waste material that can be reused or that has been normally reused in the original manufacturing process, and would not normally have entered the waste stream.

One sure way for consumers to encourage markets for recycled materials is by purchasing products with postconsumer materials. The Buy Recycled Business Alliance, a campaign of the National Recycling Coalition, which promotes the purchase of recycled content products by businesses, has identified several important issues to guide consumers of recycled products. School officials and consumers considering "buying recycled" (and students encouraging them to "buy recycled") should examine these issues to help them develop an effective campaign:

- **The scope of products available.** Recycled paper is the most common, but is not the only recycled product. Products with recycled content are available for almost any type of material. Refer to the Official

Recycled Products Guide or the Recycled Products Information Clearinghouse (see References and Contacts.)

- **Product quality and performance.** Ask manufacturers and vendors about quality. High quality products with recycled content are available, and consumers do not need to accept inferior quality or performance.
- **Product availability.** Since they are often manufactured by small companies which don't keep large inventories, recycled products may not be as readily available as other products. Check the lead time and availability of various products.
- **Types and percentages of recovered materials.** Have the vendor specify how much preconsumer and how much postconsumer material is used in each product and base your purchasing decisions on the amount and source of recycled content.
- **Product cost.** Many people think that recycled products cost more than products without recycled content. *This is often not the case*: Recycled products can cost less than, or the same as, products with no recycled content. In some cases products do cost more because of economy of scale. As the demand for recycled products increases, manufacturers will be able to produce those products more efficiently, and the cost will decrease accordingly. For this very reason, it is important to support "buy recycled" efforts!

Examples of Products with Recycled Content Currently Available

Paper Products

Adding machine tape
Construction paper
Copier paper
Corrugated and paperboard boxes
Food service bowls and trays (molded pulp)
Newsprint
Office supplies
- ***Calendars***
- ***Envelopes and mailers***
- ***Fax paper***
- ***File folders***
- ***Labels***
- ***Post-It notes***
- ***Writing tablets***

Poster board
Storage boxes
Tissue and towel products

Transportation Products

Anti-freeze
Re-refined engine oils
Retread tires

Plastic Products

Bags
Boxes, bins, containers
Food service trays
Lumber
Mats
Office supplies
- ***Desk sets***
- ***Highlighters and markers***
- ***Pens and pencils***
- ***Recharged toner cartridges***

Picnic tables and benches

Rubber Products

Bulletin boards
Floor tiles and mats
Playground equipment and surfacing
Portable bases and walkways
Speed bumps
Also many Construction Materials; Aluminum, Steel and Glass Products

In many states, school districts are able to buy recycled and manufactured products through state contracts or a state storeroom (contact the agency that does the purchasing for your State Government). Because of the large volume purchases, the contract state prices are often lower than prices available for smaller quantities. Products such as the following are available to municipalities and school districts.

Copier paper
Envelopes
Toilet tissue
Re-refined oil
Plastic lumber
Computer paper
Paper towels
Plastic trash bag liners
Retread tires

Much of the recent increase in the use of recovered materials for consumer products is a result of the demand for recycled content products by consumer, government and corporate purchasers. Manufacturers need to know that you demand high quality products made with recycled content. It may be unrealistic to expect 100% recycled content in all products because of quality or manufacturing requirements. Still, the goal is to "close the loop" by encouraging markets for recovered materials. This will help conserve natural resources.

References and Contacts
See **Background Information: Recycling.**

You will be well and comprehensively served by EPA's buy-recycled resource page:

(www.epa.gov/epaoswer/nonh-w/reduce/wstewise/$buyguid)

and the nearby question and answer page: ($buyq+a).

Also contact the Buy Recycled Business Alliance at the National Recycling Coalition (1227 King Street, Suite 105, Alexandria, VA 22314), (703) 683-9025, to ask about the Buy Recycled Guide, and about their affiliate in your state. The state affiliate will be able to tell you what's happening in your region, what other school districts have done, and which nearby manufacturers have useful items with high recycled content.

Harmony, of Boulder, CO, (800) 456-1177, publishes an informative retail catalog of "products for a healthy planet" including products made from recycled materials.

Planning Considerations

1. An effective "buy recycled" campaign in any organization requires a commitment from the administrators who actually approve purchases. After having students do some basic research to identify the issues and understand some of the recycled products available, have the students involve the administrators in the process of understanding the importance of "buying recycled." Get a commitment from the administrators to buy recycled products and to take the students' recommendations seriously.
2. "Buy recycled" efforts can be important in schools which do not yet consider recycled content in purchases and in schools that already purchase some products with recycled content. For schools already "buying recycled", additional progress can be made by increasing the percentage of recycled content, especially postconsumer material.

Suggestions for a Successful Campaign

School "Buy Recycled" Campaign

1. Present background about the benefits and the need for "buying recycled" and help students develop a presentation to school administrators and school board members.
2. Evaluate current school purchases for opportunities to "buy recycled." Use information from your school waste audit to identify high priority items in the waste stream where the recycled content (the purchasing side of the loop) can be increased in future purchases.
3. Work with the principal, office staff, academic department heads, food service director, and maintenance supervisor to identify regular purchases and upcoming special purchases. Then identify possible products with recycled content that will meet the school needs. (The school department may have written specifications for various items which preclude recycled

content; discuss the real needs those specifications are meant to serve and explore adjusting them based on new developments in recycling technology.)

4. Investigate the possibility of purchasing certain supplies in cooperation with other school districts, or with state government.
5. Research available products with recycled content, using the "References and Contacts" section above. Many venders can be reached by telephone toll-free. Also check in with local retailers. Inquire about the recycled content, quality, availability, and price of products. Match this information to the lists of products purchased by the school.
6. Present the information to the school administrators and others who make purchasing decisions. Work to get their commitment to purchase recycled products. This may take additional presentations and appeals to the school board. The more you can educate the decision makers, the more effective the campaign will be!
7. Offer to work with the purchasers to discuss options with vendors, and encourage them to challenge the vendors to provide the needed items with a higher percentage of recycled content in an acceptable price range. Be prepared to approach other suppliers if the price or quality does not compare well with previously purchased products. This process emphasizes your sincerity and will influence suppliers to provide the products consumers demand.
8. When purchases are made, inform the school community about the items, the recycled content, and the impact of the purchase on the waste stream.
9. Be sure products that are purchased meet the users' expectations for quality. Test items against the non-recycled material if there is any doubt. Provide feedback to the suppliers and manufacturers.

Home and Community "Buy Recycled" Campaign

1. Research available consumer products with recycled content. Brainstorm items with which students are familiar; refer to catalogs and sources listed above; tour supermarkets or other retail stores and discuss recycled content with the store managers and purchasers. Look at packaging as well as the products.
2. Plan effective ways to get information to families and others in the community to convince them to buy recycled products.
   - Get the approval of store mangers to put up information displays in the stores, identify specific products in the store which have recycled content.
   - Develop informational flyers or a poster campaign which identifies the reasons we should "buy recycled," identify popular products with recycled content, and locations in your community where consumers can find them.
   - Present information at public meetings (civic groups, Chamber of Commerce) to inform a wider public audience.
3. Develop a strategy to get students, families, and the public to inform retailers and manufacturers that they prefer products that have recycled content or higher percentages of recycled content. Provide enough background information and encourage people to talk directly with the store managers and to write letters directed at manufacturers of popular products.

Follow-Up

- Set up a record keeping system to track the purchase of products and to chart the school's impact on encouraging vendors to supply products with recycled content.
- Design a method to encourage the continued purchase of recycled products. Records that prove cost effectiveness and continued publicity will help keep the issue in the spotlight.

Action: Recycling

Home Recyclables Collection Center

Level
■ *Intermediate*
◆ *Advanced*

Overview

Students design collection centers for recyclables in class and "construct" a center at home. Students are encouraged to use free or inexpensive materials, and to make plans that use available space in the home. Attention is also given to informing families of local recycling opportunities and guidelines.

Background

As students learn about the amount of trash they and their families generate, many feel compelled to take waste management action. After strategies are developed to reduce and reuse waste (preferred to recycling on the *waste management hierarchy*) families need support in their recycling efforts. Getting information about recycling opportunities in the community is the first step, and setting up the process for collecting the recyclables is the next step. If curbside pick-up is not available, families may also need help (and encouragement) getting the materials to the recycling center.

See **Background Information: Recycling.**
Consider **School Recycling Program.**

Planning Considerations

1. This pathway follows naturally from **Home Waste Audit** and **Local Waste Management Options.**
2. Communicate with parents about the upcoming project and how they can be involved. Encourage them to have the students do as much of the planning and work as they possibly can.
3. Consider the preparedness of families to embark on a recycling program. Does your community or recycling center have available for distribution a handout or brochure which informs residents which materials are accepted for recycling, gives the center's hours of operation, and provides other tips to families who would like to begin recycling (bundling, crushing, removing caps and labels)? If so, be sure each of your families has a copy. If not, the class can work together on a handout that will give each family the basic information. Don't forget that there may be important recycling (returnable containers) and reuse (toy library, magazine reuse project, used clothes collection centers) opportunities that do not involve the recycling center.
4. If some families already have collection centers, those students can offer experience in the planning and team up with others who might need help.

Suggestions for Successful Projects

1. Use students' home waste audits to make a list of recyclable materials they produce at home. Compare the list to materials that are accepted for recycling at the local or regional recycling facility.
2. Discuss how much space would be needed for each type of recyclable, and the types of containers that would be appropriate. Keep in mind that the more often materials are taken to the recycling facility, the less storage space will be needed.
3. Have students draw a rough floor plan of areas of the home which might be used for storing recyclables. Then locate the collection bins on the floor plan. One of the biggest difficulties is to locate the recycling center conveniently to the kitchen (where most of the recyclables are) without creating clutter or an eyesore.
4. Brainstorm ideas for collection bins and designs for constructing them. Consider simple boxes, additional waste baskets, plastic bags supported by wood or plastic pipe frame, or even paper bags. Different materials could call for different storage method. For example, thread a piece of light rope through the handles of plastic milk jugs and hang them up out of the way. In the designs students should consider cost, appearance, and ease of construction.
5. Make drawings of the different ideas. Students then take the drawings and their floor plan home to discuss with the family. The family should work out their plan for locating and constructing the center, and for transporting the materials to the recycling facility.
6. Make labels for the storage bins.
7. Give the students about a week to build the collection center. Have them bring in a photo or drawing of the completed project.
8. When most projects are complete, share pictures in class and discuss the process. Discuss problems that came up and how they were solved.

Follow-Up

- Students can chart the amount of recyclables (weight, number of trips) their families take to a recycling facility. Set a class goal and record the progress on a thermometer-type graph.
- Make a bulletin board showing the completed projects. Display both the bulletin board and the thermometer-graph not in the classroom, but in the school corridor, where others may be encouraged to recycle.

Related Pathways

1. If there is space available, a collection center can accumulate recyclables and reuseables. Consider **Used Clothing Swap** and **Magazine Reuse Campaign**. Some families keep a large box where items can accumulate for the next neighborhood yard sale.
2. If there is not a basic recycling brochure available for widespread distribution in your community, and you were forced to create your own, consider working with local officials to improve your brochure so that it can serve the entire community.

Action

Battery Use Reduction and Rechargeable Battery Promotion

Level

■ *Intermediate*

◆ *Advanced*

Overview

Students promote alternatives to using disposable household batteries. Their research shows how dependent they are on batteries and how damaging batteries can be when they are discarded in landfills or incinerators. Students generate ideas and carry out a plan for themselves, their families, the school, and other students to reduce disposable battery use and to promote the use of rechargeable batteries.

Background

Americans throw away 2.7 billion batteries each year. Many batteries contain toxic heavy metals like mercury, cadmium, lead, and zinc. Household batteries are inefficient. At 2% efficiency, it takes fifty times more energy to make a battery than it produces for the user.

Most types of disposable household batteries are now being made without added mercury or cadmium, so the toxicity of batteries in the landfill or incinerator is not quite the problem that it once was. Household batteries continue to be a major solid waste dilemma, however, because we still throw most of them away, and because we throw them away before we have gotten anywhere near the amount of energy out of them that was put into manufacturing them. As we approach the turn of the century, the only type of household battery that is widely recharged and recycled is the rectangular nickel-cadmium (ni-cad) battery used in cell phones, power tools and cam-corders. The recharging technology and the recycling program ("1-800-8-battery") became necessary when manufacturers discovered they could not make an equivalent battery without adding cadmium (The overwhelming public voice that persuaded manufacturers to eliminate heavy metals in some batteries persuaded them to embrace the recharging and recycling of others). The other type of household battery that is widely recycled is the silver-oxide button battery, used in watches and other small devices. This is because the silver can be recovered at a profit by the jeweler who is willing to amass a significant volume. Many button batteries do not contain silver oxide, however, and are not widely recycled or reused.

Meanwhile most alkaline batteries—sizes AAA to D–go to the landfill or incinerator. Rechargeables in these sizes, and chargers that go with them, are found in many department and electronic stores and in mail-order catalogues that promote earthfriendly products. People often complain that rechargeable batteries run down much faster than disposables, and take too long to recharge. Longer-lasting rechargables are being developed, and the efficiency of these batteries is improving over time. Meanwhile solar rechargeables–relying only on the sun for energy– are growing in capability and popularity.

References

See **Background Information: Household Hazardous Waste.**

Search the web for "rechargeable batteries" and visit the sites of battery manufacturers and environmental groups. News is breaking fast on these topics.

Planning Considerations

1. It is important to understand that working with household batteries is largely a reuse (and source reduction) ***pathway***, and will only peripherally involve recycling. Ni-cad or silver-oxide button batteries may be collected, and their potential recycling promoted. Because other battery types are not recyclable, it is best to place them in the trash in small numbers, rather than concentrate their impact.
2. Students may need a jump-start with their research into battery use, the problems batteries cause, and facts about re-chargable batteries. Make a few phone calls ahead of time to locate some "experts" and the proper regulartory agencies, and do some browsing in the library and on the web.

Suggestions for a Successful Effort

1. Inventory battery-using toys and appliances at school and at home. Make lists of all products that use batteries, noting the type of battery used, the purpose of the product, and its location.
2. Discuss the reasons why we have those products (consider safety, education, convenience, recreation.)
3. Brainstorm alternatives to those products or alternative sources of power for them. Seek further information in the local community, or from printed or Internet sources.
4. Discuss and list the reasons batteries pose a problem in the waste stream. List alternatives to using disposable batteries. Seek further information in the local community, or from printed or Internet sources.
5. Gather facts about rechargeable batteries: What is their effectiveness, sources, initial cost and the cost to use them compared to disposables?
6. Contact the state agencies regulating hazardous materials and solid waste to get the latest information about battery laws and recycling efforts.
7. Brainstorm ideas for actions students can take to reduce dependence on disposable batteries. Include actions they and their families can take, actions the school can take, and ways to convince others to change their habits. Discuss and refine the brainstorm list.
8. Consider a publicity campaign to promote rechargeables in conjunction with a retailer of batteries and chargers. Find a way to include solar chargers as an option.
9. Make plans for getting those ideas to work. In small groups, prepare materials, make posters, plan presentations to others, write a report, etc. Before undertaking your project, determine a method of evaluating it.

Related Pathways

1. Perhaps, at #7 above, you considered the large number of battery-powered toys that appear over the Holidays, and decided to time your efforts to influence Christmas, Chanukah, and Kwanzaa shoppers. The Environmental Defense Fund advocates "Green Holidays" full of activities and practices in keeping with a sustainable future (go to www.edf.org.)
2. Consider scheduling this pathway to coincide with your study of electricity, energy, or economics.
3. What current information have you discovered about battery use, resuse, and recycling? Update other ***Pathways*** followers by going to www.chewonki.org.

Action: Composting

Classroom Worm Bin Project

Level

- ● Introductory
- ■ Intermediate

Materials

worm bin or lumber for bin construction

redworms (minimum 1000, or one pound)

black plastic bag or sheet

two handfuls of soil

scale

bedding material (newspaper recommended)

water

food wastes

Overview

Students and teachers set up a working worm bin in the classroom. The product is neat and relatively fast. The product is a rich compost that is an excellent soil conditioner and fertilizer. An easy way to put a classroom full of beginners into action.

Background and References:

See **Background Information: Composting.**

Worms Eat My Garbage, by Mary Appelhof, 1982, Flower Press; Kalamazoo, Michigan, is universally recommended as the bible of worm bin composting.

A search of the web brings you a great deal of credible guidance, and an array of mail order sources of redworms (as well as containers and bedding material).

Here are a few long-established suppliers:

Flowerfield Enterprises
10332 Shaver Road
Kalamazoo, MI 49002
(616) 327-0108

Beaver River Associates, Inc.
P.O. Box 94
W. Kingston, RI 02892
(401) 782-8747

The Earthworm Company
3675 Caistoga Rd.
Santa Rosa, CA 95404

Gardener's Supply Co.
128 Intervale Rd.
Burlington, VT 05010
(802) 863-1700

Happy D Ranch Worm Farm
Visalia, California
www.happydranch.com

Vermico
Merlin, Oregon
www.vermico.com

Planning Considerations

1. A container, bedding, and worms are the major ingredients necessary. All can be acquired by mail order, or produced locally.

Container. If you decide not to purchase a bin, the following guidelines may be helpful:

The container for the worm bin can be built easily out of plywood or scrap lumber. Large plastic containers and steel washtubs will also work. Consider that the size of the bin should be related to the amount of food wastes that will be composted.

Depth: The worm bedding should never be more than eight to twelve inches deep, so the bin does not need to be more than sixteen inches deep.

Length and width: In general, *one square foot of surface area will be necessary for each pound of waste that will be added during the course of a week.* (Thus, if one pound of waste is added each day at school, approximately five square feet of surface area are needed for the worm bin. A two-foot by three-foot bin should suffice in this case.) Before acquiring a bin, in order to insure the correct size, estimate or weigh the food wastes that the classroom produces each week.

Air holes: Whatever your bin looks like it will need several dime-sized holes in the bottom for aeration and drainage. These holes will keep the worms healthy and odor-free. Place a sheet of screen or mesh inside the bin on the bottom to minimize leakage and discourage fruit flies.

Bedding: Many materials are suitable bedding, including machine-shredded newsprint, hand-shredded newsprint, partially decomposed leaves, peat moss, and manure. For simplicity and cost-effectiveness, fine, hand-shredded newsprint is recommended. *Between 1.5 and 2 pounds of dry bedding are necessary for each square foot of surface area.* (Thus, a two-foot by three-foot box will need between nine and twelve pounds of dry bedding.) Water will be added to this later.

Worms: Redworms are the preferred variety of worms for composting, as they will digest food rapidly and reproduce quickly. The number of redworms needed will depend on the amount of waste that is put into the system. In general, *the worms will be able to handle half of their body weight a day in garbage.* (Thus, if you expect one pound of waste a day, two pounds of worms should be purchased.) Redworms are plentiful in old compost heaps. We recommend the assistance of a local expert in transferring them to your worm bin.

2. The earlier in the school year this project is begun, the more production will be enjoyed. Plan to use the compost in a classroom project or in another highly visible way. As June approaches perhaps a student will want to take the bin home, and you can start a fresh one in September.

Suggestions for a Successful Project

1. Construct the bin ahead of time. Preparation of the bin, in class, will take about an hour. Locate the bin in a cool place, where it's ok for a bit of dirt to leak onto the floor.
2. **Preparing the Bedding:** The bedding should have a moisture content of approximately 75% by weight. *This means that for every pound of bedding, the bin will need nearly three pounds of water.* (This sounds like a lot, but remember that a pound of shredded newspaper is a lot of newspaper, and water weighs one pound per pint. Your bedding should be able to absorb all the water. A good test for proper moisture content is to squeeze a handful of the damp bedding. If three or four drops of water come out, the bedding is perfect.)
   It may be easiest to prepare the bedding by adding water a little at a time to the dry bedding in a separate bucket or bag, and then placing it in the worm bin. *Be sure to include two handfuls of soil!* The worms will ingest the soil particles to help them grind up food wastes inside their digestive tracts.
3. **Adding the Worms:** When the bedding is prepared, add the worms to the bin. They will immediately squirm into the bedding to avoid the light. Cover the bin with a sheet of black plastic which has been cut to the size of the bin. (A solid lid may be convenient, but should not be airtight.) You are now ready to add food wastes!

Classroom Worm Bin Project

4. **Adding Food Waste:** The smaller the food scraps, the faster the worms will digest them. Break up banana peels and bread slices. Worms also like coffee grounds and tea bags. Don't put in too much food at first because any uneaten food will rot. Slowly increase the amount and variety of food scraps.

   Avoid meats, which can smell bad during decomposition, and dairy products. Also citrus rinds, onion, tobacco, and egg shells.

   Non-biodegradable items should never be put in the bin, especially wrappers and other packaging.

   When food wastes are added, they should be placed under the bedding in an area where foods have not been deposited recently. This will keep the worms moving around the bin and prevent fruit flies from laying eggs in the uncovered food wastes. Always cover the bin again with the plastic sheet to retain moisture.
5. **Maintaining the Worm Bin:** The worm bin needs very little maintenance. The worms will reproduce on their own quite effectively as long as they are getting enough air and food. Every three months or so, however, the compost will need to be harvested. To harvest the dark, nutrient-rich worm castings, push all of the contents of your bin to one side and add fresh bedding material and food to the other side of the bin. In a few days the worms will have migrated to the fresh side and you can scoop out the worm castings without getting any worms. Also, leaving the cover off for a short while before harvesting the castings will send the worms to the bottom of the container away from light and you can scoop the castings off the top. The compost can be used directly for planting projects. If the worms are not fed for a period of months, most will die.

   Keep an eye on the moisture content of your bin. If water is pooling on the bottom of your worm bin, remove it with a sponge or turkey baster. Excess moisture can kill worms and produce foul odors. Do not place the worm composter in direct sunlight.
6. Rotate the worm bin duties so that all the students get a chance to bury the wastes. Note the opportunities all along this ***pathway*** to acquaint beginning students with measuring, scaling, and charting.

Discussion

- Continue to discuss student observations about what is happening inside the worm bin. Do the records of how much waste has been put in each day help the class determine when too much has been added?

Cafeteria Composting Project

Overview

Students and teachers initiate and manage compost piles to process food wastes from the cafeteria. The finished compost can be used for school or home planting projects.

Level

- ● ***Introductory***
- ■ ***Intermediate***
- ◆ ***Advanced***

Materials

compost bin or lumber for construction (see plans on the following pages and references)

food wastes

containers for food wastes

yard wastes

pitchfork

access to water

Background and Resources

See **Background Information: Composting.**

Both Backyard Composting, and The Rodale Book of Composting, listed in the bibliography, have stood the test of time.

Much good information about composting is easily accessible on the web. Consider assigning intermediate students some introductory research on the web, at a library, or by interviewing an experienced composter.

Planning Considerations

1. Find an experienced composter to be a "class consultant" on this project. It will be important to have someone around who can point out the challenges you will face (composting in the winter, for instance), and who can provide encouragement if initial efforts should be disappointing.
2. Before embarking on this project discuss your plans with school, cafeteria, and maintenance leaders. Ask for their suggestions, and be prepared to assure them that imposition on staff will be minimal and that the composting operation will be safe and neat. Meet also with staff to get input and to outline the benefits of the project. Maintenance and cafeteria staff can be among your strongest allies in keeping the project running smoothly.
3. At a large school, the amount of organic waste generated in the cafeteria can be overwhelming. Plan to compost a modest amount of wastes in the beginning and increase the volume as you gain experience.
4. You will need a variety of ingredients and materials for a successful compost pile. They are spelled out below in detail.

Container. This can be built or purchased, but any container will work that:
1) is big enough to allow for substantial heating up (at least 3' X 3' X 3');
2) provides plenty of air to the decomposing materials;
3) can withstand heat and moisture;

It will also be helpful to have a container that:
1) is convenient for turning the pile;
2) has a cover to retain moisture (and keep out rainwater);
3) is sturdy enough to keep materials in and animals out;
4) has at least two separate compartments.

On the following pages you will find plans for constructing several types of compost bin. The plans and drawings may stimulate other designs. Perhaps a small group of students would be interested in constructing a bin ahead of time, with the help of a parent or teacher. Avoid attempting to engage an entire class in such a project.

It is possible to compost in a pit dug out of the ground. This may be the only way to keep composting through the winter.

Compost bins can also be purchased at most hardware stores or nurseries. Specialized compost containers can cost anywhere from $25 to $100 for a small capacity unit (5-20 bushels).

The location of the container can be important to the success of the project. A shady spot that is close to the source of wastes will keep the pile cool in hot weather and make for easy transportation of materials. Discuss possible sites for the compost bin with the class.

Action: Composting

Cafeteria Composting Project

The components of compost. A successful compost pile needs four main ingredients. You should keep these in mind as you start and maintain your composting project.

- **Organic wastes high in nitrogen.** Microorganisms use nitrogen to build their bodies. Food scraps, conveniently, contain significant quantities of this element. Other sources of nitrogen include animal manure, fresh green grass clippings, bone meal, and blood meal.
- **Organic wastes high in carbon.** Microorganisms get their energy from complex carbon molecules. Dry leaves are an excellent source of carbon, as well as sawdust, straw, and shredded paper.
- **Moisture.** Water is an important part of a healthy atmosphere for decomposing microbes. Pond water or rain water is preferable to tap water, which may contain chlorine and other additives.
- **Oxygen.** Aerobic microorganisms need oxygen to carry out decomposition. This can be provided by turning the pile with a pitchfork every two or three days. If adequate oxygen is not present, *anaerobic* microorganisms will take over the decomposition process, resulting in foul odors and slower composting.

Decomposing microorganisms. All the bacteria that are necessary for composting are naturally present in the environment, especially in soil. As long as favorable conditions exist in the pile, these bacteria will reproduce rapidly and carry out the composting process.

Waste Collection. Use the **School Waste Audit** to analyze the cafeteria waste stream ahead of time. The best food wastes for composting include fruit and vegetable scraps and remains, breads, pastas, grains, coffee grounds, and tea bags. These can be combined with leaves, sawdust, and dry grass clippings from the school grounds. Although shredded paper in moderate amounts is easily compostable, it may not be advisable to collect it in the cafeteria.

Place well-marked receptacles in the cafeteria to collect compostable wastes.

Publicity. Inform the entire school of your composting project. Educate the school community about separating food wastes into the proper receptacles.

Labor. Students and teachers will need to maintain the compost pile, by regularly collecting and adding food waste and the carbon source, and by turning the pile every few days and monitoring its moisture.

Patience. Even if you employ all the right tricks, it will probably take at least 6 weeks for your complete pile to become finished compost. Start early in the fall or spring in seasonal climates. Finished compost can be stored indefinitely.

Suggestions for a Successful Composting Project

1. As you begin to consider composting, take the class to visit a few backyard or farm compost heaps if you can. Perhaps one or more of the students composts at home.
2. If carbon-based materials are not available at school, seek sources of shredded waste paper or find out how to get sawdust from a local lumberyard or farm. These high-carbon materials can be stockpiled next to your bin and added to the compost pile as necessary.
3. When you are ready to begin composting, collect cafeteria wastes every day after lunch and place the food waste (high nitrogen) in the bin. Cover this with two additional parts of the high carbon leaves, sawdust, or paper. Green grass clippings are a good alternative source of nitrogen.
4. If necessary, add water until the pile is as moist as a squeezed-out sponge. If water leaks out of the pile, it is too moist. Waste milk can be substituted for water.
5. Turn the pile very thoroughly (10-15 minutes) with a pitchfork twice each week while the pile is working. This will provide enough oxygen for odor-free composting.

6. When the pile of composting materials fills the bin, stop adding organic wastes. Turn this pile every three or four days *without adding new materials* to keep it well aerated. Before long the compost should be cool, earthy, and dark in color. It is finished at this point, and can be put in bags or piles to cure or put directly on planting projects as a soil amendment.
7. During the time when you cannot add new wastes to the pile, it is a good idea to start a second compost pile. When one bin is full of composting materials, you can build a new pile in the other bin. This will allow for continuous processing of cafeteria wastes.
8. Monitor the pile for:

   Temperature. The compost pile should warm up to 90° - 140°F within a few days. If it does not heat up, the pile is either too dry or lacking in nitrogen. Add what is necessary and turn the pile thoroughly.

   Moisture. If white, powdery fungus grows on the edges of the pile, the pile is too dry. A cover on the bin can help to keep moisture in.

   Odor. A pile that reeks of ammonia has too much nitrogen. High carbon materials should be blended in to alleviate this problem. A pile that smells rotten needs oxygen, which can be provided by a thorough turning with a pitchfork. In some cases, a pile that is saturated with water will also smell rotten because the excess water absorbs the oxygen in the pile and makes it unavailable to bacteria. If this occurs, dry materials should be added to the pile.
9. During the winter, composting can be difficult above ground. However, a dug-out compost pile will heat up quite well year-round if it is big enough or if it is covered and thereby insulated from the cold.
10. A compost pile does not need to be constantly attended. As long as the pile is not in the hottest stage of composting, it can be left alone over a weekend or a vacation week without problems. If the pile is at its peak, it should be turned vigorously before it is left alone. Remember, compost what you can when you can and don't worry. The compost will still be there when you return.

Discussion

- Discuss what happens inside the pile that turns the food wastes into compost.
- Record how much waste is put into the pile each day. This can be done carefully with a scale or roughly with volume estimates. Record how much compost is produced. How much did the pile diminish in size?
- Record and graph the temperature of the pile and the air daily. What are the factors affecting the composting rate at different times?
- What is the problem with composting meat and fish? With composting most dairy products? How might these problems be overcome?

Related Pathways

1. Consider **Cafeteria Source Reduction Campaign.** At this point, while attempting to deal with large amounts of waste, students will more fully appreciate the virtue of source reduction. Although you will want to be careful about overwhelming cafeteria staff, these two ***pathways*** might be merged in a number of different ways.

Action: Composting

Plans for Constructing Compost Bins

Wire-Mesh Holding Unit

Materials

at least a 10-foot length of 32-inch-wide 1-inch galvanized chicken wire

or

at least a 10-foot length of 1/2-inch-wide hardware cloth (Note: The maximum bin diameter for a given length of chicken wire is the length of the chicken wire divided by 3.14.)

heavy wire for ties

three or four 4-foot tall wooden or metal posts (for chicken wire bin.)

Tools

heavy-duty wire or tin snips

pliers

hammer (for chicken wire bin)

metal file (for hardware cloth bin)

work gloves

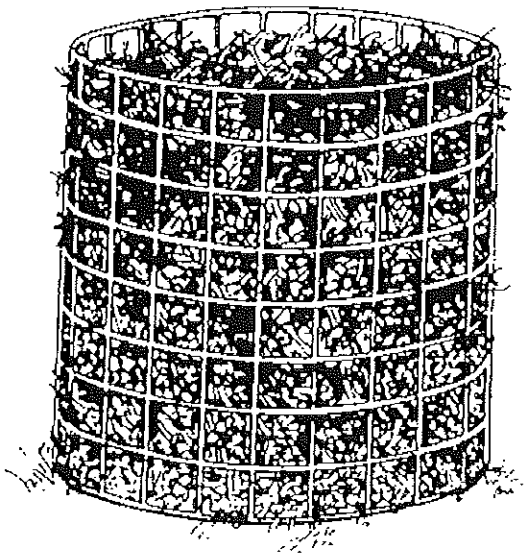
A wire-mesh holding unit is inexpensive and easy to build out of either galvanized chicken wire or hardware cloth. (Nongalvanized chicken wire can also be used, but will not last very long.) Posts provide more stability for a chicken wire bin, but make the bin difficult to move. A wire-mesh bin made without posts is easy to lift, and provides access to the compost that is already "done" at the bottom of the pile while the compost at the top of the pile is still decomposing.

Building a Wire-Mesh Holding Unit Using Chicken Wire

1. Fold back 3 or 4 inches of wire at each end of the cut piece to provide a strong, clean edge that will not poke or snag, and that will be easy to latch.
2. Stand the wire in a circle and set it in place for the compost pile.
3. Cut the heavy wire into lengths for ties. Attach the ends of the chicken wire together with the wire ties, using pliers.
4. Space wood or metal posts around the inside of the chicken-wire circle. Holding the posts tightly against the wire, pound them firmly into the ground to provide support.

Building a Wire-Mesh Holding Unit Using Hardware Cloth

1. Trim the ends of the hardware cloth so that the wires are flush with a cross wire to get rid of edges that would poke or scratch hands. Lightly file each wire along the cut edge to ensure safe handling when opening and closing the bin.
2. Bend the hardware cloth into a circle, and stand it in place for the compost pile.
3. Cut the heavy wire into lengths for ties, Attach the ends of the hardware cloth together with the wire ties, using pliers.



These plans were adapted from Composting to Reduce the Waste Stream, Northeast Regional Agricultural Engineering Service Publication No. 43, Cooperative Extension; Ithaca, NY, 14853.

Plans for Constructing Compost Bins

Wooden-Pallet Holding Unit

A holding unit can be built inexpensively using wooden pallets, or pressure-treated lumber may be used to make a nicer looking bin. The costs will vary, depending on whether new lumber or pallets are used. Used pallets are often available from manufacturers and landfills.

Building a Wooden-Pallet Holding Unit

1. Nail or wire four pallets together to make a four-sided bin at least 3 feet x 3 feet. The bin is then ready to use.
2. A fifth pallet can be used as a base to allow more air to get into the pile and to increase the stability of the bin.

Building a Holding Unit Using Lumber

1. Saw the 8-foot lengths of 2 x 4 pressure-treated lumber into four pieces, each 4 feet long, to be used as corner posts.
2. Choose a 3-foot square site for your compost bin. Use the sledge hammer to pound the four posts into the ground 3 feet apart, at the corners of the square.
3. Saw each of the five 12-foot boards into the 3-foot pieces. Allowing five boards to a side and, starting at the bottom, nail the boards to the posts to make a four-sided container. Leave 2 inches between the boards to allow air to get into the pile.
4 If you wish to decrease your composting time, build a second holding unit so that the wastes in one mature while you add wastes to the other.

Materials

four wooden pallets (five pallets if you want a bottom in the container), sized to make a four-sided container at least 3 feet x 3 feet x 3 feet

nails

baling wire

or

two eight-foot lengths of 2 x 4 pressure-treated lumber

five 12-foot lengths of 1 x 6 pressure-treated lumber

galvanized 8d nails (1 pound)

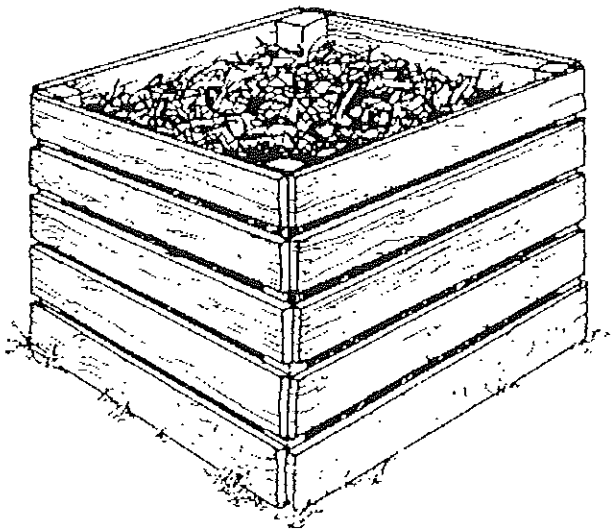
Tools

saw

sledge hammer

claw hammer

work gloves



These plans were adapted from Composting to Reduce the Waste Stream, Northeast Regional Agricultural Engineering Service Publication No. 43, Cooperative Extension; Ithaca, NY, 14853.

Action: Composting

Plans for Constructing Compost Bins

Wood-and-Wire Three-Bin Turning Unit

Materials

four 12-foot lengths of pressure-treated 2 x 4 lumber

two 10-foot lengths of pressure-treated 2 x 4 lumber

one 10-foot length of construction grade 2 x 4 lumber

one 16-foot length of 2 x 6 lumber

six 8-foot lengths of 1 x 6 lumber

a 22-foot length of 36-inch wide 1/2-inch hardware cloth

16d galvanized nails (2 pounds)

poultry wire staples (250)

twelve carriage bolts, 4 inches long, with washers and nuts

one quart wood preservative or stain

Optional materials-for lids
one 4 x 8-foot sheet of 1/2-inch exterior plywood

one 4 x 4-foot sheet of 1/2-inch exterior plywood

six 3-inch zinc-plated hinges; twenty-four 3/16-inch galvanized steel bolts, with washers and nuts

Tools

tape measure

hand saw or circular power saw

hammer

tin snips

carpenter's square

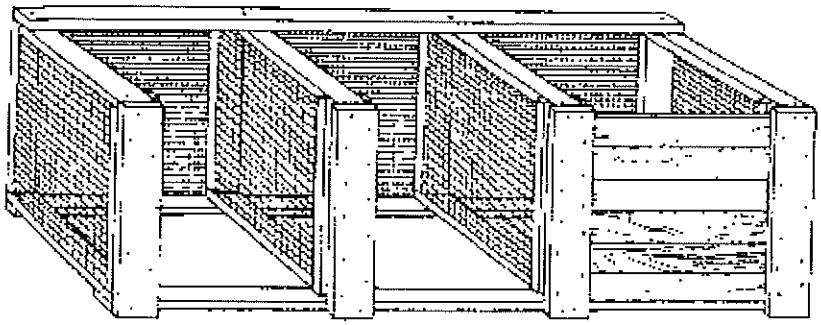
drill with 3/16-inch and 1/2-inch bits

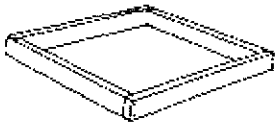
screwdriver

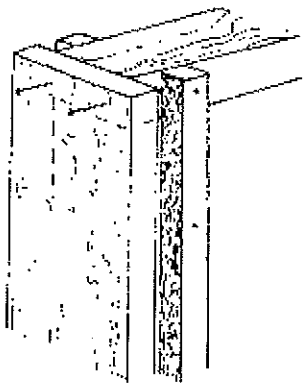
adjustable wrench

pencil

safety glasses, ear protection, dust mask, and work gloves







A wood-and-wire three-bin turning unit can be used to compost large amounts of yard, garden, and kitchen wastes in a short time. Although relatively expensive to build, it is sturdy, attractive, and should last a long time. Construction requires basic carpentry skills and tools.

Building a Wood-and-Wire Three-Bin System

1. Cut two 31 1/2-inch and two 36-inch pieces from a 12-foot length of pressure-treated 2 x 4 lumber. Butt-joint and nail the four pieces into a 35-inch x 36-inch "square." Repeat, building three more frames with the remaining 12-foot lengths of 2 x4 lumber.
2. Cut four 37-inch lengths of hardware cloth. Fold back the edges of the wire 1 inch. Stretch the pieces of hardware cloth across each frame. Make sure the corners of each frame are square and then staple the screen tightly into place every 4 inches around the edge. The wood-and-wire frames will be dividers in your composter.
3. Set two dividers on end, 9 feet apart and parallel to one another. Position the other two dividers so that they are parallel to and evenly spaced between the end dividers. Place the 36-inch edges on the ground. Measure the position of the centers of the two inside dividers along the 9-foot edge.
4. Cut a 9-foot piece from each 10-foot length of pressure-treated 2 x 4 lumber. Place the two treated boards across the tops of the dividers so that each is flush against the outer edges. Measure and mark on the 9-foot boards the center of each inside divider.
5. Line up the marks, and through each junction of board and divider, drill a 1/2-inch hole centered 1 inch from the edge. Secure boards with carriage bolts, but do not tighten them yet. Turn the unit so that the treated boards are on the bottom.
6. Cut one 9-foot piece from the 10-foot length of construction-grade 2 x 4 lumber. Attach the board to the back of the top repeating the process used to attach the base boards. Using the carpenter's square, or measuring between opposing corners, make sure the bin is square. Tighten all the bolts securely.
7. Fasten a 9-foot length of hardware cloth to the back side of the bin, with staples every 4 inches around the frame.
8. Cut four 36-inch long pieces from the 16-foot length of 2 x 6 lumber for front runners. (Save the remaining 4-foot length.) Rip-cut two of these boards to two 4 3/4-inch wide strips. (save the two remaining strips.)
9. Nail the 4 3/4-inch wide strips to the front of the outside dividers and baseboard so that they are flush on the top and the outside edges. Center the two remaining 6-inch wide boards on the front of the inside dividers flush with the top edge and nail securely.
10. Cut the remaining 4-foot length of 2 x 6 lumber into a 34-inch long piece, and then rip-cut this piece into four equal strips. Trim the two strips saved from step number eight to 34 inches. Nail each 34-inch strip to the insides of the dividers so that they are parallel to, and 1 inch away from, the boards attached to the front. This creates a 1-inch vertical slot on the inside of each divider.
11. Cut the six 8-foot lengths of 1 x 6 lumber into eighteen slats, each 31 1/4 inches long. Insert the horizontal slats, six per bin, between the dividers and into the vertical slots.
12. (Optional) Cut the 4 x 8-foot sheet of exterior plywood into two 3 x 3-foot pieces. Cut the 4 x 4-foot sheet of exterior plywood into one 3 x 3-foot piece on one of the three bins, and attach each to the back, top board with two hinges.
13. Stain all untreated wood.

These plans were adapted from Composting to Reduce the Waste Stream, Northeast Regional Agricultural Engineering Service Publication No. 43, Cooperative Extension; Ithaca, NY, 14853

Action: Composting

Plans for Constructing Compost Bins

Garbage-Can Composter

Materials

garbage can with cover

coarse sawdust, straw, or wood chips

Tools

drill

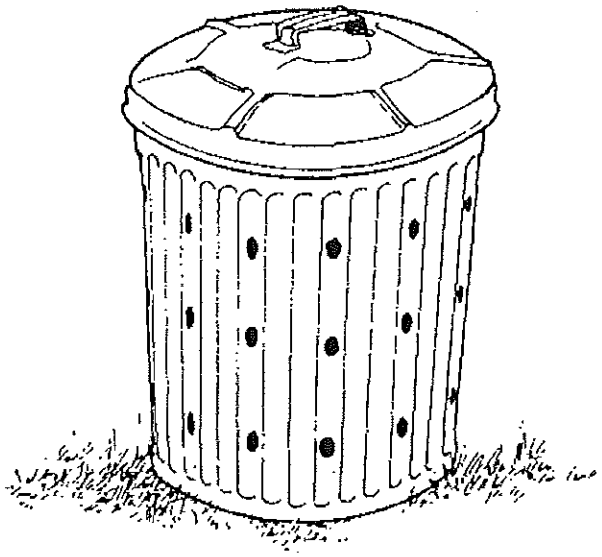
pitch fork, shovel, or compost turner

work gloves

A garbage-can composter is inexpensive and easy to build. It can be used for food or garden wastes. The wastes do, however, need to be turned.

Building a Garbage-Can Composter

1. Drill three rows of holes 4 to 6 inches all around the sides of the garbage can. Then drill several holes in the base of the garbage can. The holes allow air movement and the drainage of excess moisture.
2. Place 2 to 3 inches of dry sawdust, straw, or wood chips in the bottom of the can to absorb excess moisture and let the compost drain.



These plans were adapted from Composting to Reduce the Waste Stream, Northeast Regional Agricultural Engineering Service Publication No. 43, Cooperative Extension; Ithaca, NY, 14853.

Comparison of Waste Disposal Methods - Landfill and Waste-to-Energy

Level
■ *Intermediate*
◆ *Advanced*

Overview

This is a research project in which students compare waste-to-energy incineration and landfilling as waste management (disposal) methods. Students work in small groups to gather and evaluate information about specific issues, then come together to discuss the benefits and trade-offs of each method. Class field trips to incinerator and landfill facilities provide a foundation of information, and the occasion for plenty of interviewing. Students are encouraged to contact other waste management professionals as well, and to consult documents in the library and on the web. The class will attempt to reach a consensus about which method is preferable, and to communicate that preference to local and state officials

Background and Resources

Waste disposal is at the bottom of the Waste Management Hierarchy and is the least preferable method of dealing with MSW. See **Background Information: Landfilling.**
For a list of major incinerators and landfills in your state contact your state waste managment or planning agency. Both the agencies and the disposal facility operators themselves will have documents and bibliographical suggestions. Municipal officials, who must be aware of alternatives in order to make disposal decisions, are also good sources.

Planning Considerations

1. This project requires students to research a particular issue using sources outside the classroom. The school library may be a good resource, but encourage students to use other resources: The local library, the people at the town waste transfer station, the municipal landfill, or a nearby recycling center as sources of information.
2. Consider **Local Waste Management Options.** The flow chart will set out for students the ultimate destination of their own waste that is not reused, recycled, or composted. Does it end up in an incinerator or a landfill?
3. Plan to visit a waste-to-energy and a landfill facility on the same day. Ideally the field trip will occur halfway through the research project. Students will have completed some introductory research and will have some time ahead for follow-up. In arranging the field trip be sure that your hosts are aware of the overall scope of the project and the need for knowledgeable people to be on hand for a discussion with the students. Because time will be limited one large group question and answer session will probably prove most efficient.
4. Allow homework time for the research portion of this project. This will make it easier for students to call or visit town waste managment resources on their own. This project can be successfully conducted at several levels of sophistication. If teachers find the time to help students gain access to knowledgeable parents and professionals, complicated financial, regulatory, and scientific issues can be explored, and understood.

5. Some people that students interview may be biased when they provide information. For example, if the town landfill is a health hazard, the landfill operator may avoid questions about its safety. How can students work around this problem to verify the information they collect?

Suggestions for a Successful Project

1. The chart identifies 10 bases upon which incinerators and landfills can be compared. You may want to add or subtract issues from the list. Divide the class into small groups each of which will be responsible for examining one or two particular issues in detail, comparing incineration and landfilling.
2. This is a comparison project. Even if students are unable to come up with detailed information about an issue, they may still be able to make a meaningful comparison between the two methods of waste management. (For example, they may not determine the specific cost to build a landfill, but they may discover it is less expensive than building an incinerator. They may even be able to ap*proximate how much less expensive* it is.) Encourage students to collect information about as many facilities as they can. Avoid confining consideration to the two facilities the class visits. Facilities can vary greatly in size and in circumstances, and it will be helpful to the reliability of the general comparison if a number of different facilities are taken into consideration.
3. After information is gathered, each group should come to a conclusion about which technology is preferable with respect to their issue. (For example, "As regards operating costs, landfilling is preferable to incineration.")
4. Hold a class discussion in which each group presents their findings to the class, using relevant data to back up their conclusions. If time permits, this is a perfect opportunity for teaching communication skills used in effective presentations. It may be helpful to make a chart indicating the recommendations of each group.
5. When all groups have reported their findings help the class move toward a consensus about which method of waste disposal is preferable.
6. Evaluate the local method of waste disposal according to the class consensus.
7. Whether the class project tends to provide support for the local method of waste disposal, or to raise questions about it, communicate with local officials about your conclusions, and the basis for them. This could be done by direct presentation, by a letter drawn up by the class, by letters from individual students, or by any other method. Also, select a state official (perhaps the director of the waste management agency or the chair of the appropriate legislative committee) to contact.
8. Be sure that letters of thanks go out to all individuals who provided information and assistance. You may wish to include a description of the conclusions reached by the class which–even if it should reveal strong preferences–communicates respect for all parties.

Related Pathways

1. The opportunity exists at the conclusion of this project to point out to students that they have completed activities which are repeated over and over again in the making of public policy. They have identified and researched an issue, built a justification for a position on the issue, and communicated their position–with its justification–to those responsible for decision-making.

   Would these steps usually be sufficient to change public policy? Why or why not? If the class should seek to change waste-disposal policy, what additional steps might be called for?

Issue	*Landfilling*	*Waste-to-Energy*
1. Construction costs		
2. Operating costs		
3. Environmental costs		
a. Air pollution		
b. Groundwater contamination		
4. Regulation costs/needs		
5. Effect on waste volume		
6. Tipping fees		
7. Incentives to consumers		
8. Use of trash resources		
9. Necessary scale of operation/ need for technology		
10. Life span		

Background Information

Overview **148**

Source Reduction **152**
1 in the Waste Management Hierarchy

Reuse **155**
2 in the Waste Management Hierarchy

Recycling **157**
3 in the Waste Management Hierarchy

Composting **163**
4 in the Waste Management Hierarchy

Waste-to-Energy, Incineration **167**
5 in the Waste Management Hierarchy

Landfilling **171**
6 in the Waste Management Hierarchy

Household Hazardous Waste **174**

Background Information

Overview

Introduction

What is *waste*? For humans, waste refers to all materials for which people no longer have any use. For example, when we unwrap a candy bar, the wrapper has finished serving its purpose and becomes waste. When a farmer harvests his cornfields, the bare stalks become waste. When a minerals company mines iron ore, the earth that they must remove becomes waste. When a television set starts to broadcast snow instead of the evening news, it too becomes waste.

Waste is a natural by-product of use. Virtually all activity in the world creates waste of some kind. Even as oak leaves store energy through photosynthesis, they produce oxygen and water as biological waste. When squirrels eat seeds from pine cones, they leave behind pieces of the cones in piles of waste. When all living organisms die, their bodies become waste.

In the natural world, however, waste from one process is inevitably useful for some other process. The waste oxygen from plant photosynthesis, for example, is essential to all animals in the process of respiration. Conversely, the waste carbon dioxide from animal respiration is used in photosynthesis. Animal excrement returns valuable nutrients to the soil. The bodies of dead organisms are nourishment for other organisms. From this perspective, it is easy to see that waste is a valuable resource if it is managed properly!

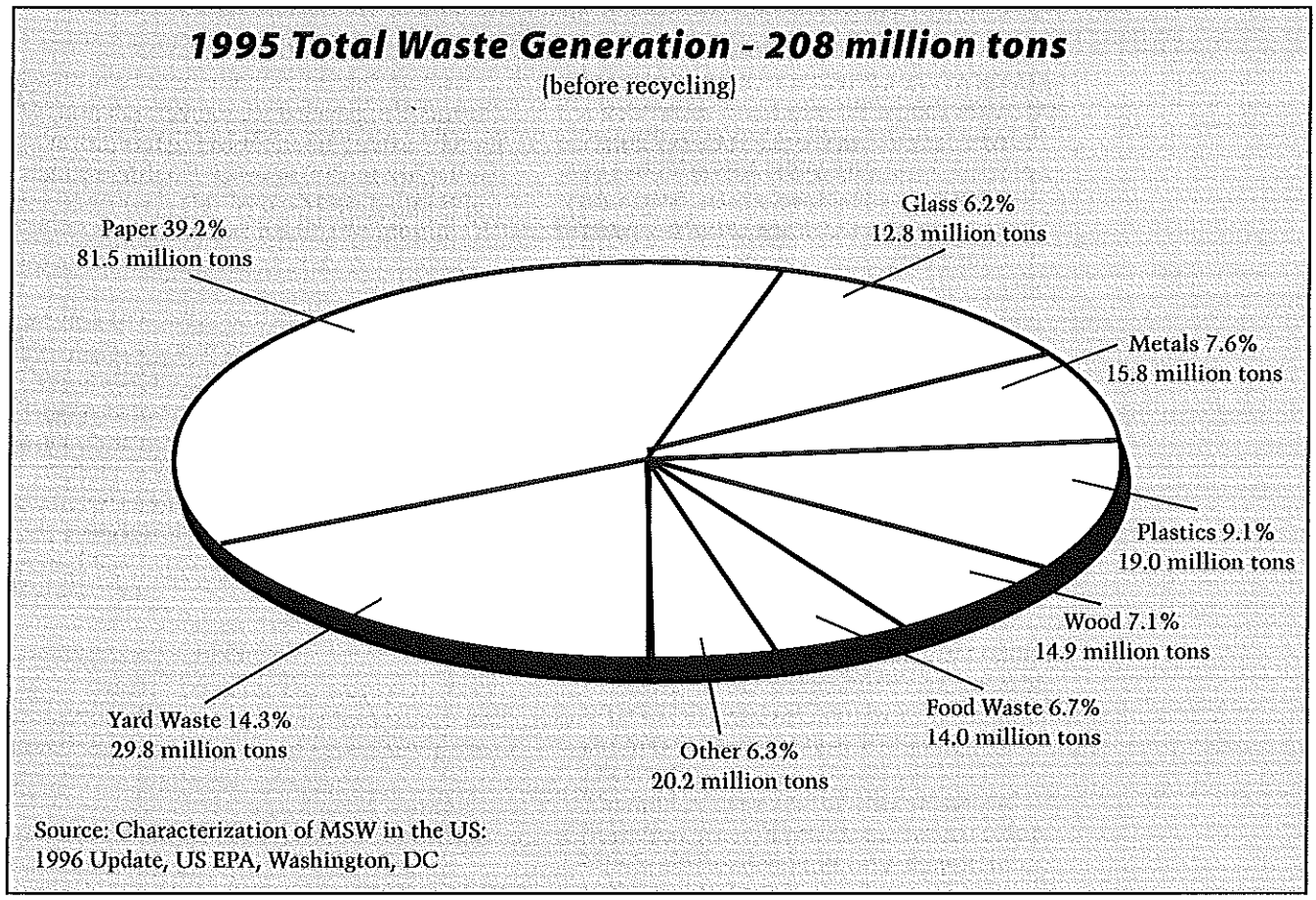
Humans could learn a good lesson from nature about waste. The waste humans generate — called *solid waste* — is a necessary and natural part of human life. However, we must find ways to manage our waste effectively to reclaim the valuable resources in the things that we no longer need! Unfortunately, this is not always easy to do. Many of the materials in the solid waste stream, especially man-made materials such as plastics and chemicals, can be difficult to use more than once. Unlike in balanced natural ecosystems, these wastes that cannot be reused in any way pile up or become hazards to the surrounding environment. Therefore, it is critical that we pay close attention to the waste that we generate and that we *do not create more waste than our environment can handle!*

Where We Are Now

The United States creates roughly 11 billion tons of solid waste every year. This includes 6 billion tons of agricultural waste, mostly in the form of crop residues and waste water; 4 billion tons of mining waste, mostly in the form of mine tailings and removed earth; and 800 million tons of industrial waste, including chemicals and waste water. (Certain types of waste water are considered solid waste.) The remaining 200 million tons (approximately) of the solid waste generated is classified as *municipal solid waste*.

Municipal solid waste (MSW) is waste that is generated by households, businesses, and state and federal governments. It is trash that people generate every day in the course of their daily routines at home and at work. It is collected in dumpsters, curbside trash cans, compost bins, and at redemption centers to be disposed of. It includes discarded packaging, food wastes, broken toys and appliances, yard wastes, waste paper, and much more.

The following graph shows the composition of MSW in the United States. Although the waste stream varies slightly around the country, the graph represents the country as a whole.



Why worry about municipal solid waste? It is true that municipal solid waste represents only 2% of the waste generated in this country. What about the 98% of all waste that is generated in agriculture, mining, and industry? This waste is certainly important to consider. It needs to be managed effectively, as does all waste. But farmers, mining companies, and industrial manufacturers manage their own waste (and pay for it) as a normal part of doing business. They use *private* facilities to compost, landfill, and incinerate virtually all the waste they generate.

The burden of managing municipal solid waste (and paying for it), however, is shared by everyone in this country, as we all share in producing it. Whereas private companies decide on their own how to manage waste, we must decide collectively, through local and state governments, how to manage municipal solid waste. It is important that, as educated citizens, we are all aware of the issues surrounding municipal solid waste disposal so that we can make good decisions about it.

Secondly, municipal solid waste generation has been increasing steadily at a rate of 3-4% annually for the last thirty years. Facilities for handling solid waste cannot accept many more materials than they already do. Therefore, municipal solid waste management is a growing problem today that needs to be addressed.

Background Information

Waste Management Hierachy

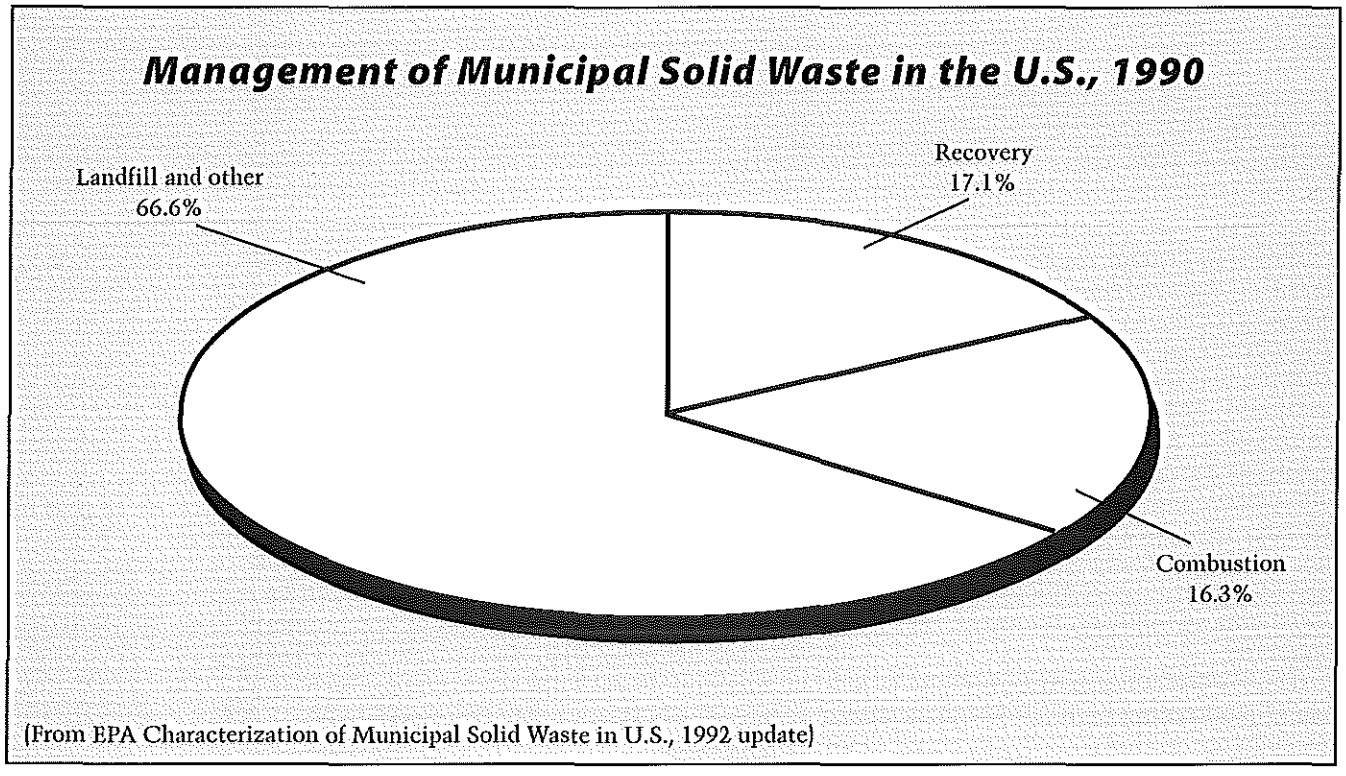
There are six major methods of managing solid waste. The United States Environmental Protection Agency (EPA) has ranked these methods in a hierarchy from most preferable to least preferable:

1. *Source reduction* - the reduction of the amount and toxicity of waste in the manufacture, packaging, and use of products;
2. *Reuse* - the use of durable products instead of disposable ones;
3. *Recycling* - the manufacture of new products from waste materials;
4. *Composting* - the biological decomposition of organic waste;
5. *Incineration* - the burning of waste, usually with energy recovery capability;
6. *Landfilling* - the burial of waste in secure facilities.

The graph below illustrates how the U.S. municipal solid waste stream was actually managed in 1990. It is revealing that landfilling and incineration, the two lowest priorities in the EPA hierarchy, are the methods of waste disposal that are most common in the United States. In spite of the high priority of source reduction, the overall size of the national waste stream continues to grow each year.

States differ significantly with regard to solid waste management. A broad beverage container deposit law and the operation of four large incinerators in Maine may help explain why landfilling accounts for less than half of the state's waste.

The number one priority in the EPA hierarchy is source reduction, which calls for a reduction in the amount and toxicity of solid waste that we create in this country. In

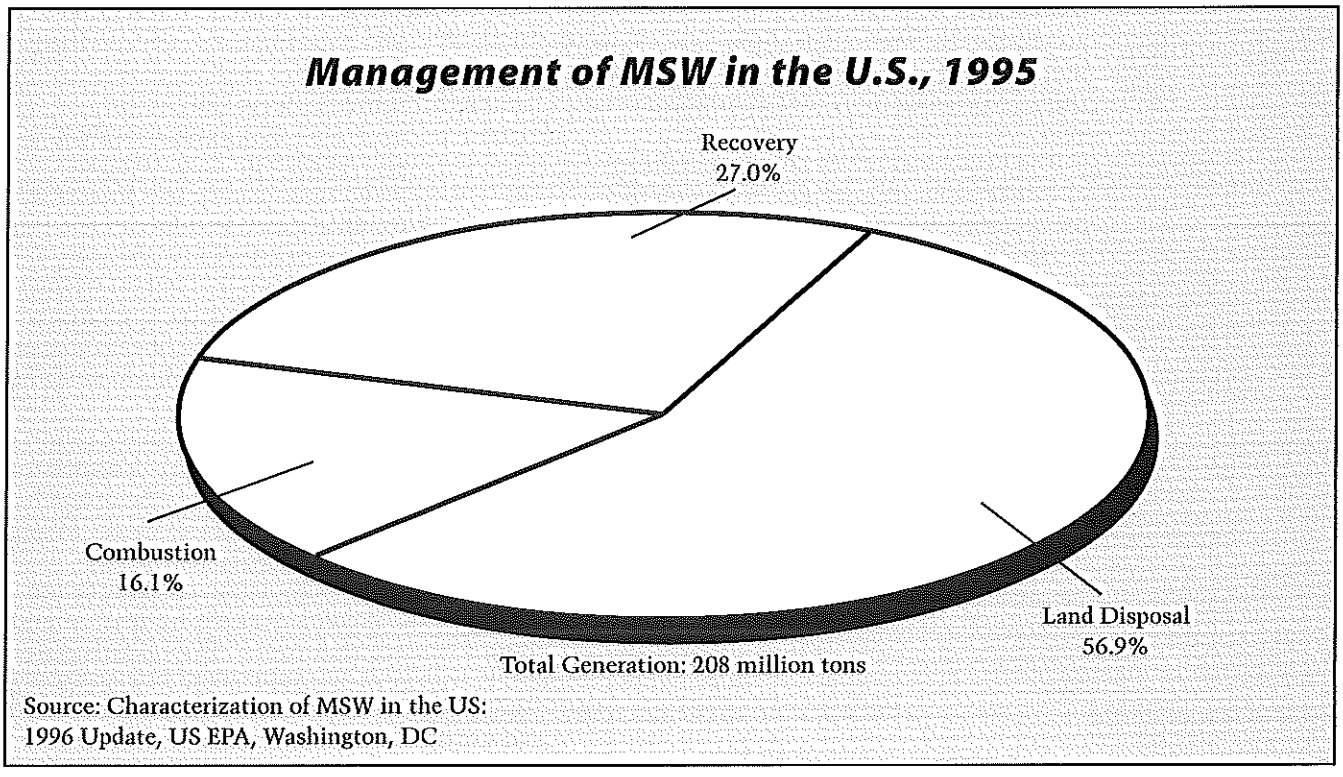


(From EPA Characterization of Municipal Solid Waste in U.S., 1992 update)

short, as we assess how to manage our waste, *where waste comes from* is even more important to consider than where it goes! Source reduction is a call to examine our *consumption* first of all when we examine waste management!

When we consider that the United States has one of the highest rates of consumption of any country in the world, it is no surprise that we also have one of the highest rates of waste generation of any nation in the world. It follows that one of the ways that we will achieve significant reduction of the waste stream will be to change our current patterns of consumption. This may require us to give up some of the convenience that we have come to expect, such as lunch platters packaged in disposable plastic packaging. It may have short term financial costs, such as the construction of recycling plants and investment in refillable bottle systems. But making wise decisions about what we buy and how we use the items that we already have is a small sacrifice to make in order to reduce our waste stream. And ultimately, in the long run, reducing our waste stream will return financial benefits as well as environmental ones.

Each method of solid waste management in the EPA hierarchy is featured in a background information section that follows.



Source: Characterization of MSW in the US: 1996 Update, US EPA, Washington, DC

Background Information

1 Source Reduction

Introduction

The most efficient, inexpensive, and environmentally sound method of managing municipal solid waste is simply to avoid producing it in the first place. Waste that is never created does not need to be collected, requires no transportation, takes up no landfill space, creates no pollution, and costs nothing to handle. Although this statement seems absurdly obvious, apparently it is not to most Americans. For all the talk about the growing problems of waste management in the United States, we keep on producing more garbage in this country every year!

Source reduction, the attempt to decrease the amount *and the toxicity* of solid waste produced, is the highest waste management priority identified by the U.S. EPA. That means as a nation and a state, we should be looking for ways to reduce the amount of waste we generate *before* we concentrate on incineration technologies and recycling programs. No method of waste management will lead to a sustainable future if we continue to produce more and more trash every year.

The biggest target for source reduction efforts is packaging which comprises 33% (by weight) of Municipal Solid Waste (MSW.) A significant reduction in packaging use would have an immediate impact on the solid waste stream.

Where We Are Now

The United States municipal solid waste stream has been growing at a rate of between 3% and 4% each year since the 1960s. Our country produced 88 million tons of solid waste in 1960 (2.7 pounds per person per day) and 195.7 million tons in 1990 (4.3 pounds per person per day). At this point, specific source reduction efforts should be focused on stopping this growth of U.S. waste production.

Waste generation has also been increasing steadily in Maine. The size of municipal waste stream actually decreased in the years between 1988-1991, in part because economic recession helped slow overall consumption in the state and, consequently, the rate of waste generation. Unfortunately, up to now healthy economies have stimulated higher levels of waste production, and Maine's economic recovery has stimulated higher and higher levels of waste production.

Source Reduction Strategies

Packaging manufacturers and consumer goods companies can follow several different paths towards the goal of source reduction. Efficient materials use is a simple path. For example, the use of light-weight materials in manufacturing, a process known as *lightweighting*, yields products that are relatively inexpensive to produce, that function well, and that create less waste. Aluminum cans are manufactured today with 30% less aluminum in each can than just 20 years ago, with little or no loss of strength. Some products, particularly laundry detergents, can be concentrated. The packaging needed for concentrated products can be significantly less than that necessary for unconcentrated products.

Even better, companies can eliminate some packaging altogether. Certain items, such as hardware goods, books, and grocery produce do not need individual packaging at all. Other items, particularly dry food items, can be sold in bulk quantities.

Consumer goods can also be made more durable than they currently are, designed for multiple use and built to last. These kinds of products will stay out of the waste stream longer than cheap alternatives. Many products can be manufactured without the use of toxic ingredients such as heavy metals and corrosive chemicals. The manufacture of batteries with significantly less mercury (a toxic heavy metal) content, is a good example.

As consumers, we can choose what products we purchase. Our choices will dictate, to a large extent, what kinds of products companies put on the shelves. If we do not purchase overpackaged items and cheaply built goods, companies will stop producing them. More importantly we need to ask ourselves before every purchase whether the item we are considering buying is necessary in the first place!

Plastic Packaging: A Source Reduction Case Study

Plastic is one of the fastest-growing sectors of the municipal solid waste stream, and is often singled out as a good target for source reduction efforts. Overall, plastics make up 8.3% of the total waste stream in the United States by weight (16.2 million tons), and 21% by volume.

The benefits we would derive from reducing the amount of plastic used in this country are substantial, beginning with the manufacturing process of plastic itself. First, plastic is made from petroleum, a nonrenewable resource, most of which must be imported from other countries. It also requires the use of five of the EPA's six most hazardous chemicals in its manufacturing process. Plastic production, in fact, is the major industrial use of four of these six chemicals. Consequently, between production and processing, plastic manufacturing creates up to ten tons of hazardous waste for every ton of plastic! Plastics production also has air pollution costs. Any reduction in demand for plastic products would be a reduction in demand for foreign petroleum and these toxic chemicals.

Reducing our use of plastic would also reduce the amount of plastic that ends up in landfills and incinerators. Since plastics are lightweight, they consume lots of landfill space for their weight. Since they do not decompose, once they are buried in a landfill they do not compact any further. Although plastics have a good fuel value for waste-to-energy incinerators, certain plastics (such as polyvinyl chloride) produce strong toxic acids and highly corrosive chemicals when burned. And both incinerators and modern landfills charge at least $40 per ton to dispose of plastics, as for all other waste.

Reducing plastic use and production in this country offers many benefits in terms of cost savings, minimizing a variety of environmental impacts, and decreasing reliance on foreign petroleum resources. Source reduction means that we do not need to find alternatives to this plastics use — we simply stop producing as many plastic products as we currently do. Although plastic products are particularly good candidates for source reduction, all source reduction efforts are directly beneficial for our waste stream and our pocketbooks.

Encouraging Source Reduction

Federal and state governments have provided some incentive for widespread source reduction efforts. The U.S. EPA has declared source reduction to be its first priority in solid waste management, even ahead of recycling or composting.

The state of Maine has gone even further. Recent laws have restricted or banned certain types of batteries that contain heavy metals and restricted the use of many toxic inks in packaging. State agencies have been called upon to practice source reduction.

Besides state government intervention, the implementation of *user fees* in municipalities can be a powerful encouragement for families to reduce the amount of trash they produce. A user fee is a price that is charged for garbage pickup, usually linked to the amount of garbage to be disposed. The more waste a household produces, the more they have to pay for removal. This economic pressure tends to encourage households to reduce waste substantially.

1 Source Reduction

Conclusion

Convenience is alluring, whether it is in the form of individually wrapped cheese slices or disposable razors. Plastic and paper for packaging are inexpensive. The patterns of consumption that we have become used to in this country are hard to break. So we continue to produce more garbage every year, even as we grumble about constructing new landfills and incinerators.

The logic behind source reduction is simple: the less we use, the less we will need to throw away; the less toxic a waste product is, the less it will harm the environment. We would be well served by looking at where our waste comes from as well as where it ends up! This means we must try to stop the growth of the waste stream and eventually turn our attention to shrinking it. To be optimistic, there has never been more room for improvement! And we all have a role to play in the effort: Ultimately, source reduction really does start with the consumer who refuses to buy wasteful products.

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2 Reuse

Introduction

In the last fifty years, there has been a growing trend in the United States to manufacture and consume single-use, disposable products. Disposable diapers, plastic milk and soda bottles, and ball point pens are examples of products that have almost completely replaced reusable alternatives in recent decades. While disposable products are often quite convenient, they waste natural resources and consume a large percentage of current landfill space.

Reusing products, either for the purpose that they were designed or for another purpose is a method of waste management. We benefit from reuse in many ways. Consider what happens when we drink from a glass, wash the glass, and put it back into the cupboard. First, we do not need to buy a paper cup which will end up in a landfill. Secondly, we do not need to use any paper, energy, or water to make the paper cup. Thirdly, we postpone the time when the glass itself will go into a landfill. And it is usually less expensive to wash the glass than it is to buy paper cups anyway!

Where We Are Now

It is very hard to estimate how much of the municipal solid waste stream (MSW) gets reused, because items that are being reused do not get put into the waste stream at all! For example, refillable bottles are collected by beverage distributors directly and are never put into household trash; if a person washes a yogurt container and uses it for holding nails, it does not get thrown into the trash to be counted as solid waste for quite some time.

Reuse is not as common as it once was. Virtually all milk sold in the United States today comes in single-use plastic-coated paper cartons or plastic jugs. Fifty years ago the majority of milk was sold in refillable glass bottles and delivered to people's doorstep. Disposable plastic-and-paper diapers now account for 90% of all diapers used in this country, although we have used them widely in only the last thirty years.

Reuse Strategies

Reuse goes beyond merely using products more than once. Consumers can choose to purchase products that are durable and designed for multiple use rather than those that are disposable. For example, cloth napkins can be purchased once and washed regularly in the place of hundreds of paper napkins. Consumers can also choose to repair broken items instead of discarding them and purchasing replacements. This takes true commitment since it may be as expensive or more expensive to repair a broken appliance as it is to buy a new one. Finally, individuals can be creative about the waste they would normally discard to find alternate uses for many materials. Old newspapers can be used as packing material; plastic milk cartons can be made into bird feeders and bird houses; the reverse side of white paper can be used as a scratch pad.

For reuse strategies to make a significant impact on the amount of waste we generate, however, packaging manufacturers must join consumers in the endeavor. In the U.S. there are few economic incentives to provide reusable or returnable packaging. Lightweight plastic and aluminum packaging can be very inexpensive in the short term, yet it adds significantly to the waste stream. As further work is done to analyze product and packaging life cycles, we will better be able to determine the true cost (including the environmental cost) of different materials.

Energy Savings and More

Reusable packaging may offer the most efficient way to package goods. Two consumer goods studies completed in the last fifteen years found that refillable glass bottles provided the most energy efficient method of delivering beverages to stores, requiring 1/10th the energy in manufacturing as plastic bottles made from virgin plastic and 1/5th the energy as recycled aluminum cans. (These studies assumed that the glass bottles could be reused eight to ten times, and in practice, reusable bottles can often be used up to 50 times!) Initially, reusable

packaging such as refillable bottles cost as much to produce as other containers, but subsequent uses of the packaging require only the energy to wash the bottles, not the energy to melt aluminum or mold plastic. The washing process required with reusable packaging also creates less air, water, and solid pollution than the production of new containers.

Reusable products save consumers lots of money on waste disposal. Landfilling the 18 billion disposable diapers used in this country every year costs between 100 and 300 million dollars in the form of landfill and incinerator *tipping fees*! Indirectly, this money comes from consumers through taxes or waste disposal fees. Reusable cloth diapers, on the other hand, can be reused hundreds of times before they require disposal and thereby offer considerable savings in the area of disposal costs alone.

Conclusion

Reusing products is a simple way to decrease the amount of waste that we need to throw away. We can help ourselves by purchasing products that will last a long time, by repairing broken appliances, and by finding new uses for old products.

As a society, we can encourage companies to manufacture reusable packaging and durable products.

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3 Recycling

Introduction

In its literal sense, the word *recycle* means to turn over again. Recycling is one of the most publicized methods of waste management in the United States, and is the process of turning old products into new ones. However, recycling is distinguished from reusing in that it entails some reprocessing of materials. For example, aluminum cans are recycled when they are melted down and remolded into new cans; glass deposit bottles are reused when they are washed and refilled.

Recycling is a valuable method of handling certain solid wastes, for the simple reason that it diverts materials from landfills and incinerators. Its greatest value may be as an alternative to the manufacture of all products from raw materials. This is economically sensible and it conserves natural resources! Many materials can be recycled, including aluminum, steel, tin, and other metals; glass; a wide variety of paper products; many types of plastic; and miscellaneous other materials such as waste oil, paint, and textiles. These materials that can be recycled are called recyclable materials. It is important to distinguish between these "recyclables" and actual recycled products, which are made out of reprocessed materials.

Recycling is not as simple as landfilling or incineration, however! It requires a strong commitment from *everyone* if it is to be successful. Companies must manufacture products with recyclable and recycled materials; towns and individuals must collect recyclable wastes; the government must support recycling on all levels; and perhaps most importantly, people must create the demand for recycling and "close the loop" by buying recycled products!

Where We Are Now

In 1990, 17.1% of all wastes generated in the United States (by weight) were recycled, led by aluminum which achieved a recycling rate of 38.1%. (A "recycling rate" refers to the percentage of a given material that is culled out of the waste stream and reprocessed into a new product.) This 17% recycling rate represents a slight improvement over previous years, but a much higher rate can be achieved. An experimental recycling program in an East Hampton, New York neighborhood achieved an overall recycling rate of 84%!

Maine has one of the highest recycling rates of any state in the country. In 1991, Maine residents recycled 28.7% of all municipal solid waste. (This includes a composting rate of 0.7%; therefore, recycling excluding composting totaled 28.0%.) This high rate is due in part to Maine's bottle bill, state laws that require recycling of office paper and corrugated cardboard, and aggressive recycling goals set in the Maine Solid Waste Management Plan. Ultimately, Maine residents are willing to participate in recycling programs. In 1995 90% of Maine residents had access to recycling programs. Since that time, however, the overall costs of solid waste managment, in Maine and throughout the U.S., have skyrocketed. A few Maine communities have closed their recycling centers, believing that they will thereby reduce municipal expenses.

Recycling Rates for Selected Materials

	U.S. 1990	*Maine 1991*
Paper and Paperboard	28.6%	32%
Glass	19.9%	70%
Metals	23.0%	81%
Aluminum	*38.1%*	*68%*
Steel/Ferrous metals	*15.4%*	*83%*
Plastics	2.2%	15%
Textiles	4.3%	34%
Overall Recycling Rate, All Materials	***17.1%***	***29%***

Background Information

Collection of Recyclables

The first step in any recycling program is the collection of used materials. There are many ways that this happens, but success usually requires consumer cooperation. Some towns have voluntary collection programs in which residents can choose to bring in recyclable goods such as plastic milk jugs and steel food cans to a town recycling center. Some towns have *curbside pickup* programs in which a collector picks up separated recyclable materials, just like household trash collection. Maine and other states have laws, often called bottle deposit legislation, or *bottle bills*, which give individuals a small cash rebate (5-15 cents per container in Maine) for returning beverage containers to redemption centers. In Maine, all of the bottles and cans that are collected through this law are recycled, a total of 94% of all bottles and cans covered by the law.

Even if consumers do not separate materials out of the waste stream for recycling, sometimes valuable materials are saved for recycling before they are landfilled or incinerated. At refuse-derived fuel incinerators, metals, glass, and some other materials are culled out of the waste stream before incineration to be recycled.

Finally, manufacturers often recycle their own waste. Paper companies, for example, recycle the wood scraps and paper pulp that are left over after the paper manufacturing process; metal manufacturers recycle scrap steel from the forging process. This saves them money and materials.

Average Prices of Recyclable Materials Paid by Brokers to Municipalities in Maine, 1993

Material	*Avg. sale price, per ton*
Aluminum cans	$430
Plastics, PET (Soft drink containers)	106
Plastics, HDPE (Milk jugs)	236
Paper, high grade office	55
Newspaper	20
Old Corrugated Cardboard	15
Glass, clear	26
Tin cans	57

Markets for Recyclables

Recyclable materials, once they are collected, often become a valuable commodity. Town recycling centers can sell some of these bulk materials to brokers — and the town can avoid landfill tipping fees at the same time! (See chart below.) The brokers may be willing to pay for many materials because they can in turn sell the recyclable materials to manufacturers. And the manufacturers are willing to buy the bulk recyclable materials because they can substitute recyclables for raw materials at a competitive cost. As long as consumers are willing to purchase products with recycled materials, markets for recyclable materials will continue to improve.

PAPER

Waste paper comes to recycled paper mills in large bales. Some mills accept only certain kinds of waste paper — such as newsprint, high grade office paper, or cardboard — but the recycling process for all of these papers is similar. The waste paper is shredded and added to water in a large blender called a *hydrapulper*. Spinning blades in the hydrapulper beat the paper until the individual paper fibers separate which usually takes about 15-20 minutes. The resulting mixture, or *slurry*, is about 2% fibers and 98% water, and it can be used alone or combined with new pulp to make new paper. Depending on what kind of new paper will be made, the slurry may need to be de-inked. However, nearly 50% of all U.S. recycled pulp is used in new paper products that do not need de-inked fibers, such as grocery bags, cardboard, and paperboard.

Recycling paper is not entirely efficient, however. Some of the fibers in recycled pulp become too short in the process to be used in making new paper. These short fibers, approximately 10% (by weight) of the waste paper, are removed from the pulp and must be burned, composted, or landfilled.

Furthermore, waste papers are often recycled into "lower use" products. Waste newspaper does not always get recycled into newsprint; often it gets recycled into paperboard or tissue paper. Consider that nearly two-thirds (63.9%) of all high-grade office paper recovered from the municipal solid waste stream is recycled into "lower use" products such as tissue paper, paperboard, or containerboard, which usually cannot be

recycled themselves. In this sense, much of our paper recycling efforts postpone some form of eventual disposal.

Consumers should also be aware that recycled papers are not always made from used waste paper, such as old newspapers or office paper. "Recycled papers" can also be made out of wood scraps and other paper mill wastes. The percentage of the pulp used in making new recycled paper that comes from paper used and then collected for recycling is called its *post-consumer* recycled content. The percentage that comes from waste materials collected in the mill and diverted from the waste stream is called *pre-consumer* recycled content. While the use of both kinds of recycled content in paper manufacturing helps reduce the demand for unused pulp, the purchase of papers with a high post-consumer recycled content (the higher the better) helps to stimulate the markets for recycling paper products.

ALUMINUM

Aluminum is one of the easiest and most efficient materials to recycle. When scrap aluminum comes to recycling plants, it is put into furnaces and heated into molten aluminum. During the heating process, impurities, including paints, are burned off. (Aluminum beverage can recycling often includes a step that removes the paint from cans before they are put into the furnace.) This purified molten aluminum is then alloyed, if necessary, poured into molds, and formed into ingots. The ingots are later shaped into new aluminum products. This process is much simpler and cheaper than producing pure aluminum from bauxite ore. It takes less than 1/20th of the energy to produce recycled aluminum as it takes to produce unused aluminum! The manufacture of recycled aluminum also generates less air, water, and solid pollution than the original manufacture of aluminum.

In 1990, 38.1% of all aluminum in municipal solid waste in this country was recycled, including 62.4% of all aluminum beverage cans. Maine residents recycled 47% of aluminum in the waste stream, including over 90% of all aluminum cans; all of these are shipped out of the state for recycling.

STEEL

Steel is recycled through a process very similar to the aluminum recycling process. Scrap steel and steel cans ("tin" food cans are actually steel cans with thin coating of tin) are sorted according to their alloy, melted down in high temperature furnaces, purified, and reformed into ingots. These ingots are later remelted and poured into molds for shaping into new steel products. This saves over half the energy of initially manufacturing steel and contributes significantly less air and water pollution.

Although the official U.S. recycling rate for steel in municipal solid waste is relatively low (15.4%), recycled steel accounts for a large percentage of all steel produced in this country. Virtually all steel produced today has some recycled content, and according to the Steel Recycling Institute, 40% of all steel produced in the U.S. has 100% recycled content. If the steel recycling rate is so low, where does all the used steel come from? It comes from old buildings that are torn down, old automobiles, and other sources that do not ever figure into calculations of steel recycling from municipal solid waste. The Steel Recycling Institute claims that the amount of steel collected for recycling each year from all sources equals two-thirds of the amount of total steel produced in the U.S.

GLASS

Aside from the fact that glass has three different colors, it is easy to recycle. Clear glass is the most valuable since it can be remanufactured into any color, while green or brown glass can only be made back into a dark color. First, used glass is crushed into small pieces, called *cullet*, and screened for foreign objects such as bottle caps and small stones. The cullet is then melted in a furnace to make molten glass where it is typically combined with unused glass. This molten mixture is later poured into molds or blown into new glass products.

While recycling glass does not save much energy over making new glass from sand, it does have several advantages. Recycling glass requires relatively little water, creates no mining wastes and produces very little air pollution.

Just under 20% of all glass in the U.S. waste stream is recycled, while a healthy 70% of all glass is recycled in Maine, due in part to the state's bottle bill.

③ Recycling

PLASTICS

Plastics are quite cumbersome to recycle, since the many different kinds that we discard into the waste stream, must be recycled separately. In general, however, all plastics are recycled by a similar process: First, they are separated by type according to the chasing arrow symbol embedded into the product (see chart below). They are chopped into small pieces, washed with soap and water, and dried. The plastics may be screened for impurities several times during the washing and drying process. The dry, uncontaminated plastic chips are then melted in a furnace and transformed into molten plastic which is pressed through a die, resulting in long strands of plastic. The strands are cooled in water and chopped into pellets. These pellets are later reheated and molded into new plastic products.

The fact that there are many different kinds of plastic *resins*, or *polymers*, used for plastic products -which must be recycled separately- contributes to the inefficiency of plastic recycling. The chasing arrow/number symbols used on plastic containers help consumers separate the resins for recycling, yet sorting plastics is expensive and a significant obstacle to recycling. Even some plastics made of the same resin must be separated for recycling because of the process used to make them (e.g. blow-molded HDPE laundry and soap jugs vs. injection-molded HDPE margarine containers.) Furthermore, some products are manufactured with two, three, or even four different kinds of plastic, which make resins very expensive to properly sort and recycle.

Plastics lose strength every time they are recycled as the long chains of molecules are

Plastic Container Code System

(voluntary code system developed by the Society of the Plastics Industry, Inc.)

Symbol	Abbreviation	Some of the Materials that use this type of container
1 PETE	PET (PETE)	polyethylene terephthalate - soft drink bottles
2 HDPE	HDPE	high density polyethylene - milk bottles, detergent bottles, orange juicebottles, some shopping bags
3 PVC	V (PVC)	vinyl (polyvinyl chloride) - shampoo bottles, salad dressing bottles, vinyl seats
4 LDPE	LDPE	low density polyethylene - shopping bags
5 PP	PP	polypropylene - catsup bottles, yogurt cups
6 PS	PS	polystyrene - foam cups, prescription bottles, plastic knives, forks, spoons
7 OTHER	OTHER	mixed or multiple layer plastics

broken into shorter and shorter pieces in the chopping and melting processes. This means that recycled plastics are almost always manufactured into "lower use" products. For example, soft drink bottles are usually made into detergent bottles, scouring pads, or polyester fiber. These products, in turn, can only be made into such things as plastic flowerpots or plastic lumber; these products may not be recyclable at all. Consequently, unused plastic must be used for all the new plastic soft drink containers and milk jugs that are produced; plastic recycling, in its current stage, is merely a partial solution to the problem of plastic waste management.

One hopeful development is the new concept of "design for disassembly" and "design for recycling." Manufacturers are beginning to create products which can be taken apart at the factory and the components easily separated for recycling. They are also designing these products to be made from materials that are more effectively recycled.

The difficulty of plastic recycling is evident. Nationally, a meager 2.2% of all plastics in the solid waste stream were recycled in 1990, mostly milk jugs and soda containers.

Conclusion

Recycling is an important way for us to handle some of our solid waste. It provides some obvious benefits: It diverts waste from landfills at the same time that it conserves natural resources. Every ton of paper that is made from recycled fiber saves three cubic yards of landfill space and over three tons of wood. Markets for recyclable goods are a source of income for municipalities which must pay tipping fees. As these markets expand, municipalities should reap the benefits in the form of even higher prices for recyclable materials. Furthermore, recycling helps to make all of us aware of the waste we generate, and even may help us to produce less waste in the first place.

In the next decade, we may recycle nearly half of all the waste we generate in this country! While this is an admirable goal, recycling is not a cure-all. It has its costs, too. Consider that all 100,000 tons of metals, 7,000 tons of textiles, 45,000 tons of glass, and 12,000 tons of plastic collected for recycling in Maine in 1991 were transported out of the state for recycling. This transportation has significant environmental and economic costs! Recycling also requires time and commitment from consumers, and recycled products can be more expensive than the original products.

The benefits of recycling do outweigh the costs. Recycling rates are on the increase for nearly all materials in this country, and more people are recycling than ever before. There is still much work to be done! Ultimately, recycling needs to be seen for what it is: A way to retrieve valuable resources from the waste stream after we have removed as much as possible by reducing, reusing and remanufacturing.

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4 Composting

Background Information

Introduction

Decomposition is the name we give to the natural recycling of organic (living) matter. When a plant or animal of any kind dies, the remains become nourishment for other creatures and the surrounding soil. Thus, when leaves fall from the trees in autumn, they enrich the soil on the forest floor; when a deer dies in the forest, its carcass is consumed by coyotes, beetles, and ultimately, billions of microorganisms in the soil. In this way, valuable nutrients carried in the bodies of dead organisms are returned to the environment.

Composting, then, is a special form of decomposition. It is human-aided decomposition for the purpose of resource recovery. When we compost organic materials, we combine them in such a way and under such conditions as to optimize the natural process of decomposition. When the process is complete, the result is *finished compost* that weighs less and occupies less volume than the original waste. More importantly, the finished compost is a valuable soil amendment that has been sterilized by heat generated during decomposition and is thus free of pathogenic (disease) bacteria and weed seeds.

Where We Are Now

In Maine, one-third of all municipal solid waste is food and yard wastes, which can be easily composted. An additional one-third of the waste stream is paper, some of which can also be composted. This means that up to half of Maine's solid waste could be composted and thereby diverted from incinerators and landfills, and returned to the land in the form of finished compost. In 1991, only 10,790 tons of municipal waste were actually composted in Maine, or less than 1% of all municipal waste. Maine was representative of the country as a whole; less than 1% of all municipal solid waste in the United States was composted in that year.

The Composting Process

In order for composting to be successful, the right conditions must exist. First, organic materials must be gathered to provide carbon and nitrogen in the proper amounts. Complex carbon molecules provide energy to the microorganisms that carry out the decomposition process. It is their 'food.' Nitrogen and simple carbon molecules are used to build the bodies of more microorganisms as they grow and reproduce.

For aerobic decomposition–the fastest method of composting–to occur, oxygen is also necessary. This is usually provided by 'turning' the compost pile every few days. The oxygen is required for aerobic microorganisms to 'breathe.' If oxygen is not available, as in a compost pile that is not turned, *anaerobic* microorganisms take over the decomposition process. These microbes are slower to decompose the pile than the aerobic microorganisms, but given enough time, they, too, will produce finished compost. One disadvantage of anaerobic decomposition is that it tends to produce foul odors as it proceeds.

Finally, water is needed for successful composting. Since many of the materials that go into the pile already contain water (such as vegetable wastes), it may not be necessary to add more water. In any case, a moisture content of 40-60% is desirable, which is about the moisture content of a squeezed-out sponge. If the compost pile is saturated, necessary oxygen will dissolve in the water and become unavailable to aerobic bacterial decomposers.

Sufficient carbon, nitrogen, oxygen, and water provide favorable conditions for the reproduction of a variety of naturally occurring microbes that do the work of the aerobic composting process. In the first *psychrophilic* stage, simple bacteria that thrive in cool temperatures (45-60° F) secrete enzymes that allow them to consume easily available carbohydrates. This breakdown of organic matter produces carbon dioxide, water vapor, and heat, which causes the temperature of the pile to rise rapidly.

4 Composting

When the temperature reaches approximately 70° F, conditions become unfavorable for cool-temperature bacteria, and they begin to die. In their place, warm-temperature *mesophilic* bacteria continue a similar decomposition process, generating more carbon dioxide, water vapor, and heat. The mesophilic bacteria thrive up to approximately 104° F, reproducing rapidly and continuing to consume carbohydrates.

Beyond 104° F, the mesophilic bacteria cannot survive, and conditions become optimal for high-temperature *thermophilic* microorganisms. These more complex bacteria, fungi, and molds continue to consume carbohydrates but also attack cellulose, lignin, and fats in the organic matter. This produces still more water vapor and heat, so that the temperature of the pile can reach up to 160° F and beyond. At approximately 158° F, conditions start to become unfavorable for even these thermophilic microbes to survive, so that temperatures over 160° F cannot be maintained for long periods of time.

It is very important that the pile gives off heat. First, higher temperatures in the compost pile increase the level of microbial activity, speeding up the decomposition process. Second, temperatures of 155° F effectively kill the harmful vectors (pathogens) of plant and human diseases that may have been present in the original materials, such as *Salmonella* and *E. coli*. Substantial heat also renders most plant seeds sterile, which means that finished compost will not sprout weeds wherever it is applied to the soil. Finally, high temperatures in the pile will help to keep harmful and annoying insects away and will prevent any of these insects from reproducing in the pile.

High temperatures persist in aerobic decomposition as long as there are sufficient amounts of carbon, nitrogen, oxygen, and moisture present. Of course, additional oxygen can be provided to the pile by turning, and water can be sprayed on the pile to keep it moist, but after several days, there will not be enough carbon or nitrogen to sustain a high level of microbial activity. Slowly, the temperature of the pile will decrease as these organisms produce less heat.

When the pile gets cool enough, *macroorganisms* such as earthworms, sowbugs, mites, millipedes, and beetles will move into the pile to continue the decomposition process. There is never a dull moment in the life of a compost pile!

We call the end product of the 'hot' composting cycle *finished compost*, although decomposition continues to take place slowly in the cooled-down pile. Finished compost is a dark, earthy, crumbly substance with a pleasant aroma. It is made up of partially decomposed organic matter, billions of living microbes (which continue to carry out the process of decomposition) microbial skeletons, inorganic particles, and perhaps most importantly, *humus* (pronounced HYOO-muss).

Humus is the substance in finished compost that is chiefly responsible for providing nutrients to plants. It is extremely complex in its composition, being made up of many different compounds organized in many different ways. Among its constituent parts are an assortment of proteins and a wide variety of acids (called *humic acids*). However, no two humus particles are exactly the same. Humus is the ultimate end-product of decomposition in the sense that it is constructed from those portions of organic matter that are resistant to further breakdown.

Plants, Soil, and Compost

Compost provides many things to plants which foster healthy growth. Perhaps most importantly, compost supplies plants with nutrients: mineral nitrogen, which plants use as the protein building blocks of their bodies; common but necessary minerals such as phosphorous and potassium; and trace elements such as zinc and magnesium. These nutrients help plants to thrive and produce healthy fruits and vegetables, colorful flowers, and full foliage.

Compost also helps plants by improving soil structure. It lightens dense soils and provides organic matter, increases water retention, and improves aeration in any soil. Among other things, this allows good plant root growth, provides favorable conditions for healthy soil bacteria, and helps plants survive times of drought.

Compost benefits soil and plants in many other ways, too. It acts as a sort of 'buffer' for soils by making plants less sensitive to soil acidity or alkalinity. It also helps soil to absorb heat from sunlight, which can result in a longer growing season. It provides excellent protection against soil erosion. It can actually destroy toxic waste in soil. Finally, it promotes the growth of helpful soil bacteria, including some that produce soil antibiotics against common plant pathogens.

How and Why?

One efficient way to make compost is to maintain a pile in the backyard. Compost can be successfully produced from ordinary yard wastes including grass clippings, fallen leaves, and food scraps. This is highly efficient because it does not require transportation of materials or heavy machinery, and because most nutrients are returned to their source, namely, your backyard. There are several styles of backyard composters, some are inexpensive. See **Cafeteria Composting Project**, or the references listed here.

Some municipalities have developed solid waste composting projects, including mixed waste composting and yard and leaf waste composting. As of 1992, there were 21 facilities in the U.S. that were composting unseparated municipal solid waste. Since composting mixed household trash creates many technical problems, many states prefer source-separated composting. In 1992, there were nearly 3,000 facilities composting leaves, grass, brush, and other yard trimmings.

Conclusion

Composting is one way that we can begin to manage our waste with an efficient natural process. It is an inexpensive and environmentally sound method that can be used to turn a large percentage of our waste into a useful commodity. It is also practical on a small scale. In these ways, it is an improvement on many current waste disposal methods such as landfilling and incineration. As the waste disposal problem in our state and in our nation continues to grow, we must aggressively use composting as a major means for managing organic wastes.

4 Composting

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5 Incineration

Background Information

Introduction

Incineration, the process of burning waste to reduce its volume and weight, has long been practiced in the United States. The first U.S. incinerator began to operate in 1885 on Governor's Island, New York as an alternative to the direct dumping of waste. Since that time, many incinerators have also used the energy released from burning waste to generate steam or electricity as a by-product, employing aptly-named "waste-to-energy" technology.

Incinerators have often been hailed as the best solution for solid waste disposal, but concerns persist today over this technology. While burning waste reduces it by 60-90% in weight and volume, the ash residue must still be buried or disposed of in some fashion. Furthermore, this ash and the gases released during incineration can be toxic to humans and the environment unless properly treated with pollution control devices. And incineration is an expensive method of dealing with waste, from the construction of the incinerator itself to the daily maintenance and operation of the plant.

Where We Are Now

Nearly 17% of all municipal solid waste generated in the United States in 1990 was incinerated. This represents a decrease from the 1960s when nearly one-third of all waste in the U.S. went up in flames, but an increase since the late 1980s, when less than ten percent of U.S. waste was burned. Incineration has fluctuated in prominence throughout its history in this country, largely due to changing public perceptions about its safety. In recent years, improving pollution control technology has led to a resurgence in incineration as a waste management strategy. As of 1989, there were 167 incinerators operating in the United States, with 25 more under construction and 94 in the planning stages.

The vast majority of existing incinerators employ waste-to-energy technology. Over one million homes in the United States use electricity that is generated in waste-to-energy plants, and this number is increasing.

Maine incinerates a large portion of its waste. In 1991, 37% of Maine waste was incinerated, over double the national average. This means more waste is incinerated in the state than landfilled!

Maine has four waste-to-energy incinerators. In 1993 the facility in the Portland area generated 20% of the residential electricity demand for its 20 member municipalities, nearly 100,000 megawatt hours.

What Happens in an Incinerator

There are two major kinds of incinerators operating in the United States today. Both kinds can burn up to 3,000 tons of waste per day. Three-fourths of all incinerators are called *mass burn* incinerators. These plants burn virtually the entire waste stream, including metals and glass, in high-temperature furnaces. Only a tiny fraction of the waste stream is culled out before incineration, including *white goods* such as discarded refrigerators and washing machines and any obvious hazardous materials such as automobile batteries. These rejected materials are recycled or sent to landfills for disposal.

Refuse-derived fuel (RDF) incinerators cull out 5-8% of the waste stream before incineration with a series of sorting machines. As waste is delivered to the facility, it is put on a conveyor belt and passed through a series of grinders and hammers which smash the waste into small pieces. Strong magnets separate out ferrous metals and complex screen systems cull out glass and other noncombustible materials for recycling or appropriate disposal. The remainder of the waste, made up of mostly plastics, paper, and other organic materials, can be stored or burned in a high-temperature furnace. In general, RDF plants are more expensive to operate than mass burn incinerators, due to the additional machinery that they require. However, they provide a more efficient fuel for incineration than mass burn plants, and RDF plants can recycle the materials that are culled out of the waste stream.

The furnaces in both mass burn and RDF incinerators operate on the same principles. Waste materials are fed into a furnace on a

conveyor belt where they burn at high temperatures in an oxygen-rich environment. Ash drops to the bottom of the furnace (called *bottom ash*), is cooled, and is mechanically removed. Heat, gases, and airborne particles (called *fly ash*) that are produced in the combustion process flow through a series of pollution control devices and are filtered out or released into the air. The ash that is produced in the incineration process is usually buried separately in specialized landfills called *monofills* or *ashfills*.

In waste-to-energy incinerators, the heat that is generated from burning wastes heats up a boiler which produces steam. As in most nuclear, oil, and coal-fired power plants, this steam is then used to drive a turbine, which produces electricity.

Incineration Hazards

Incinerators utilize extensive modern technology to operate safely and within environmental safety limits. However, they are *potentially* hazardous in a variety of ways. Both the smoke generated by burning waste and the ash leftover after incineration have many hazardous components. The smoke contains large quantities of several gases that are considered atmospheric pollutants. They include carbon monoxide, nitrogen dioxide, sulfur dioxide, and a variety of hydrocarbon gases which are major contributors to urban smog and acid rain.

The smoke from waste combustion also contains toxic *heavy metal* ions such as lead, mercury, and arsenic. When metallic wastes such as batteries are incinerated, some of the metals are transformed from relatively stable forms to unstable, free ions. In this form, they are quite toxic to humans; most are believed to be carcinogenic and many have been linked to a variety of other digestive, nervous, and respiratory disorders.

Thirdly, the smoke in an incinerator furnace contains minute amounts of other hazardous gaseous compounds, most notably *dioxins* and *furans*. These are chemicals that are believed to be among the most toxic chemicals in the world, producing adverse health effects in animals even in extremely low concentrations.

In addition, smoke from waste combustion contains a variety of particles which are carried by the hot, rising gases. Some of these particles are actually airborne ashes, called *fly ash*. Studies have shown that heavy metals and dioxins can adhere to ash and other particulates in significant quantities. All airborne particles (*particulates*) less than 10 microns wide are a health hazard on their own, too, contributing to a variety of respiratory diseases in humans and animals.

Finally, when ash is landfilled, it is fairly stable, but it can pose the same problems of leaching contaminants into ground and surface water that municipal solid waste landfills pose. The ash that is produced in the incineration of municipal solid waste is also toxic; both *bottom ash*, collected from the bottom of the furnace after incineration, and fly ash. Both fly ash and bottom ash contain toxic compounds.

Pollution Controls

Fortunately, the potential hazards of incineration can be controlled in a variety of ways. Each individual incinerator is managed differently, but all are required to meet certain pollution standards designed to protect public health. Pollution standards are set by the EPA on a national level, but many states set their own, tougher standards. As of 1993, maximum permissible levels for seven *criteria pollutants* in incinerator emissions had been identified by the EPA. (While there are more than seven toxic substances produced in incineration, these seven pollutants serve as indicators of the overall cleanliness of the emissions.) The methods of pollution control mentioned here are some of the most common methods used in incinerators.

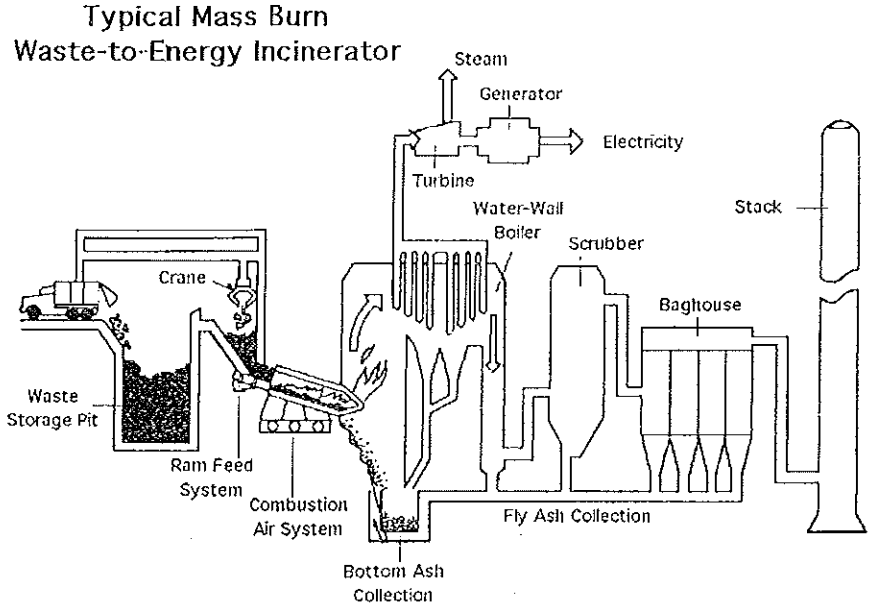
First, metals and other materials that may become toxic if burned can be separated out of the waste stream before combustion, as in RDF incinerators. This ensures a more efficient fuel source for these incinerators which produce less harmful emissions.

Secondly, a high temperature can be maintained in the furnace, which encourages complete combustion of all materials. Air can be forced into the furnace by huge fans that keep the fire raging. The gases released in complete combustion are less toxic than fumes from 'low' temperature combustion; in particular, high temperatures are less likely to produce dioxins.

The gases that are released during even the most complete combustion are still harmful, however, and they contain toxic fly ash and other particulate matter. In all incinerators, they pass through a series of *scrubbers* which make the gases safe enough to be emitted into the air. There are many different types of scrubbers. *Wet/dry scrubbers* spray a limewater slurry into the hot gases as they emerge from the furnace. The calcium in the lime reacts with any acid gases and transforms them into relatively harmless solid compounds which can be collected and landfilled. *Baghouse filters* mechanically filter particles out of the incinerator exhaust. *Electrostatic precipitators* remove particles by means of a powerful electric charge.

Through a variety of methods, then, the emissions from incinerators are made safe enough to meet pollution standards. Unfortunately, all the hazardous materials (e.g. heavy metals and dioxins) that are filtered out of the **gases** by pollution control devices end up in the **residues** leftover after the incineration process is complete (bottom ash, fly ash, calcium compounds, particulates, etc.). Scrubbers do not eliminate pollutants; they merely capture them before they can be emitted into the air. This makes it clear why incinerator ash and other residues must be disposed of appropriately, in secure facilities.

Typical Mass Burn Waste-to-Energy Incinerator



U.S. Environmental Protection Agency

Note: The illustration represents a typical mass burn incinerator. Refuse Derived Fuel (RDF) incinerators use a process which differs dramatically at the "front end." RDF plants separate the waste and remove recyclables before the fuel enters the incinerator.

5 Incineration

Incineration Costs

Incineration has typically been a very expensive method of waste management. The cost to construct a large new incinerator that will meet all EPA and state regulations can run into the hundreds of millions of dollars. Incinerators have high operating costs, too, due to the complex machinery that they require and the expenses associated with ash disposal. These costs can be partially offset by electricity generation in waste-to-energy plants, but incinerators receive income by charging a *tipping fee* to dump wastes at the incinerator. Because incinerators are expensive to operate, tipping fees charged at incinerators tend to be higher than those charged at landfills. In Maine, tipping fees are similar for both landfills and incinerators. The four large incinerators in the state charge an average tipping fee of $45 per ton (1993); the largest landfills in the state charge tipping fees of approximately $55 per ton.

Conclusion

Incineration can be an alluring method of waste disposal. By reducing the volume of waste that must be landfilled, it provides a partial solution to the pressing problem of landfill shortages. It can produce energy as a by-product. However, some argue that incineration works against more important source reduction and recycling efforts because incinerators require huge volumes of garbage every day to keep operating. For example, many incinerators require towns that bring their waste for incineration to sign 'put or pay' contracts which guarantee that the towns will deliver the same amount of trash every year or pay for it anyway. Thus, incineration does not encourage us to change our lifestyles to produce less waste. Furthermore, it requires expensive technology to be safe and, like most major industrial operations, it does carry some risk. How much risk it carries is hard to quantify accurately. Certainly as the technology in incineration improves, it will become safer.

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6 Landfilling

Introduction

Land disposal is the oldest and most common form of waste management in the United States. Until the second half of this century, waste was deposited in *open dumps*, literally exposed piles of garbage; today waste is taken to specific *landfill* sites for disposal. When wastes are taken to a landfill, they are dumped, compacted, and covered with soil. Over a long period of time, materials may begin to decompose in the landfill, but in general, the wastes remain in the ground more or less intact for many years. Studies have found perfectly legible newspapers that have survived for two decades in landfills, next to whole apples and chicken bones with meat still on them!

While land disposal has been the solution to our waste problems for many years, landfills have always presented a number of problems to people and the environment. They can produce odors, provide a breeding ground for undesirable insects and disease, attract animals, and contaminate air, water, and soil. These problems were rampant in the open dumps that existed throughout the country in the early 20th century, although most concerns can be addressed today through modern technology. Even the most technologically advanced landfills, however, have a significant impact on their local environment.

Where We Are Now

In recent years, the amount of available landfill space in the United States has decreased rapidly. This has happened for three reasons: 1) many existing landfills have reached maximum capacity and have been forced to close due to lack of space; 2) many existing landfills, opened before strict federal and state regulations were in place, have been shut down based on environmental concerns; 3) strong public opposition has prevented the construction of many new landfill facilities that will meet all regulations. Fifteen years ago, over 20,000 landfills existed in the United States. In 1992, there were fewer than 5,000.

This decline in landfill space nationally is quite alarming in light of the fact that the amount of trash Americans produce continues to increase every year, and according to BioCycle magazine, in 1992 over 70% of this municipal solid waste was destined for landfills.

Landfilling Costs

One reason land disposal has historically been the primary method of waste management in the United States is that it was inexpensive. Before federal and state governments began to regulate landfills, trash was dumped in city or county dumps for nominal fees. Today, landfills must be designed, constructed, managed, and monitored with expensive equipment and heavy machinery. A 1990 study conducted for the state of Michigan estimated development and construction costs for a state-of-the-art 80-acre landfill to exceed $30 million! Operation costs can approach hundreds of thousands of dollars annually, and closure and post-closure costs have been estimated at nearly $5 million over thirty years. In short, landfilling is no longer cheap! As a result, landfill *tipping fees*, the prices charged for dumping trash in landfills, are increasing in most parts of the country. In 1993, Maine's largest modern sanitary (or secure) landfills charged tipping fees of approximately $55 per ton.

What Happens in a Landfill

Wastes are generally delivered to modern landfills in garbage trucks. Wastes are dumped, compacted, piled ten to thirty feet high and covered with soil. At the end of each day, any exposed waste is covered with additional soil. In this way, wastes are buried in *cells*, distinct areas separated by soil. After the entire surface of the landfill is covered with one layer of waste, additional cells can be constructed on top of the wastes. Some landfills are built up nearly 100 feet above the level of the surrounding land. When a landfill reaches capacity, it must be covered with several additional feet

of topsoil, and the surface can be replanted with vegetation. Many closed landfills have been used as parks, golf courses, or recreational areas.

Landfill Hazards

Most landfills pose the threat of contaminating groundwater, especially in a state like Maine where there is a high water table and regular precipitation. When rainwater percolates through the materials in landfills, it becomes contaminated and seeps into the ground below as *leachate*. The leachate becomes acidified in the landfill through biochemical processes and consequently can carry toxic materials out of the wastes and into the ground. In particular, heavy metal ions can be leached out of wastes and into groundwater, streams, or lakes.

Some decomposition of wastes does occur in landfills. One by-product of this biological breakdown is methane gas. Methane is an atmospheric pollutant, is potentially explosive, and can kill vegetation on closed landfill sites by starving plants of oxygen. Other gases that are produced by the biological breakdown of wastes include carbon dioxide and hydrogen sulfide.

There are other less serious nuisances caused by landfills. If they are not properly maintained, they often attract animals who scavenge for food. They can also produce odors and are unsightly additions to any landscape while in active use.

The Modern "Secure" Landfill

Modern landfills are sometimes referred to as secure landfills due to their sophisticated design which aims to minimize environmental risks. Under current EPA regulations, new landfills are required by law to be constructed with a clay and/or plastic *composite liner* on the bottom which will be impermeable to leachate. Landfills that have this liner are called *secure* landfills. Rainwater can also be diverted from the landfill with the installation of plastic caps or covers, which helps to minimize leachate formation. Any leachate that does form in 'secure' landfills must be collected in pipes at the bottom and pumped up to the ground for treatment. Modern landfills are also required to have wells drilled adjacent to the site which are monitored for any signs of contamination.

Methane gas management is also regulated by the EPA. At most landfills, methane production is simply monitored to insure proper venting into the atmosphere. Some landfills collect methane and burn it off as a waste product; a few landfills even collect the methane to burn for the purpose of generating electricity.

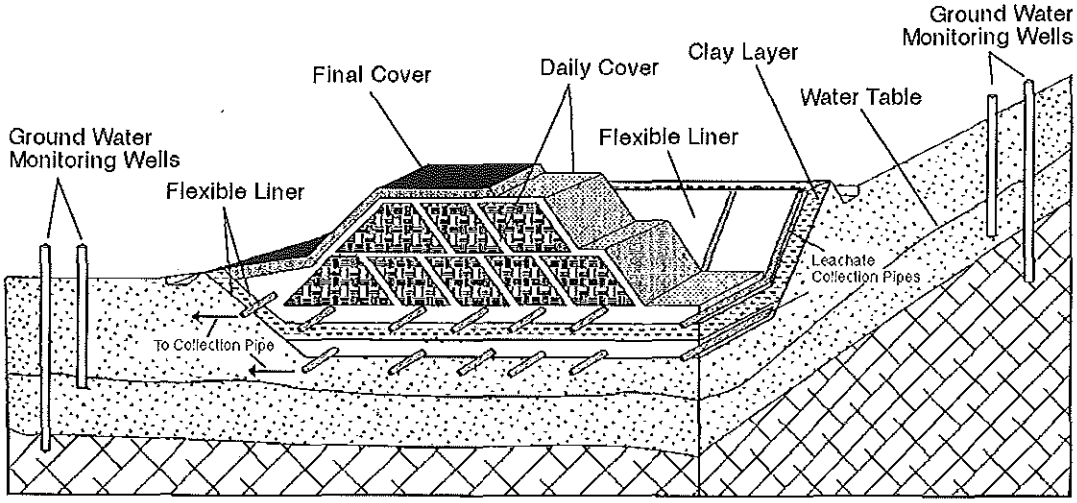
Unfortunately, these and other technological advances are not standard features on all landfills. Current EPA regulations notwithstanding, many landfills that opened years ago continue to operate without any means of controlling leachate or methane. As of 1988, before the current EPA regulations went into effect, it was estimated that only 25 percent of existing U.S. landfills monitored groundwater for leachate contamination, only 15 percent had clay or synthetic liners, and just 5 percent collected leachate for treatment.

Conclusion

The technology that is making landfills safer and less offensive is truly a double-edged sword. It makes disposing of wastes in the ground environmentally acceptable, but accepting this convenient method of discarding our refuse may blind us to alternative waste management strategies such as recycling and composting which may ultimately be more environmentally sound. Furthermore, as sanitary landfill technology becomes more sophisticated, environmental protection will come at a higher price.

Ultimately, no amount of technology will change the fact that landfills put valuable resources into the ground where they cannot be reused. It is only when we put materials into the ground that they truly become 'waste.' Landfilling, then, is really a last resort for dealing with solid waste. According to the EPA, it is the least attractive

Modern Secure Landfill



Siting Office, Maine Waste Management Agency

method of waste disposal after waste reduction, reuse, recycling, composting, and incineration. The days of dumping waste because it is simple and cheap are long since over.

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Background Information

Household Hazardous Wastes

Introduction

Any material is considered hazardous if it is reactive, ignitable, toxic, radioactive, or has dangerous biological characteristics. Hazardous wastes have been front-page news for many years and strict federal laws are now in place to regulate the disposal of hazardous wastes produced by industrial and commercial generators. Hazardous wastes produced at home are exempt from federal or state disposal regulation, yet there are few local facilities or programs which allow homeowners to safely dispose of their hazardous wastes. As a result, the disposal of household hazardous waste in household trash or sewage systems can contaminate the air, soil, and groundwater.

All citizens must understand the dangers of improper waste disposal and work to create acceptable disposal options. The most effective strategy to address household hazardous wastes is to reduce the amount of wastes produced in the first place and to reduce the toxicity of those wastes. There are many effective alternatives to hazardous materials used in the home to help us all reduce household hazardous wastes at home and at school.

Where We Are Now

The average American generates 15 pounds of household hazardous waste each year. This accounts for 1-2% of the municipal solid waste generated in the United States. Because these wastes are exempt from federal and state hazardous waste regulation, most of this waste goes improperly to local disposal facilities, sewage treatment plants, septic systems, or down storm drains. These disposal methods pose environmental and public health problems.

Some states are making efforts to reduce the environmental impact of household hazardous wastes by eliminating certain wastes from landfills, by setting up material-specific collections, by educating consumers, and by requiring manufacturers to reduce the hazardous material content in consumer products. Collection programs for hazardous materials have been initiated in many states and communities around the country.

Production and disposal of hazardous wastes are as much a problem in schools as they are for households. Schools use household and industrial strength cleaners, solvents, polishes, paints, and pesticides which can be hazardous to custodial staff, teachers, and students. These materials must be disposed of properly to avoid contaminating the environment. In addition, schools often stock hazardous chemicals for science, art, or vocational classes. Since state and federal laws protect employees in the workplace, hazardous materials in all schools are regulated by the Occupational Safety and Health Administration (OSHA) and monitored by state labor agencies. The Industrial Safety Division of the Department of Labor provides training for school personnel involved with the handling and disposal of hazardous substances.

Maine initiated a major hazardous materials cleaup of its schools in 1989. This process required each school to inventory hazardous materials and remove unnecessary chemicals and dangerous products. Many extremely hazardous and potentially explosive materials were removed from storerooms and guidelines were established to limit the re-accumulation of these materials. Now, school officials are required to list all hazardous materials used in each building and update the inventory annually. Schools are not allowed to purchase more than a 2-year supply of any hazardous substance and are required to inventory household products purchased in industrial quantities (case lots.) Usually the supervisor of buildings and maintenance for the school district or the transportation manager keeps the inventories along with the required Material Safety Data Sheets for each hazardous substance or product.

What Materials Are Hazardous?

Most information on household hazardous waste considers only hazardous materials which are corrosive, reactive, flammable and/or toxic. Radioactive and infectious

biological wastes are not usually considered in the *household* hazardous category although there are some consumer products that contain small amounts of radioactive material, notably smoke detectors. Manufacturers of household smoke detectors are required to accept used units for disposal. Televisions actually produce small amounts of ionizing radiation (X-rays), though they are not radioactive themselves. For infectious wastes, the health care industry has strict guidelines to prevent the spread of AIDS, the Hepatitis B virus, or other biohazards. School personnel are trained to handle biological wastes that could possibly be encountered in school settings. Baby diapers and other sanitary products are also potentially infectious waste. The corrosive, reactive, flammable and/or toxic materials usually considered as household hazardous waste are much more common and problematic in home and school settings.

Hazardous materials are classified according to their harmful characteristics. Many products have more than one of these characteristics:

Corrosive materials destroy metal surfaces or burn living tissue. They can be highly acidic or caustic. Examples include drain cleaners, toilet bowl cleaners, oven cleaners, batteries, pool chemicals, and chlorine bleach.

Reactive materials can generate heat and become explosive when they react with substances around them, and may create toxic fumes. Examples include picric acid (used in some science labs) welding material, certain pesticides (zinc phosphate), and bleach cleaners.

Flammable materials can burst into flames when they come in contact with sparks or flames. They have a flash point of less than 140° F. Examples include motor oil, gasoline, oil-based paints and lacquers, paint strippers and thinners, some nail polishes, hair sprays, and other aerosol products.

Toxic materials cause illness, injury or death through ingestion, inhalation, or absorption. They can cause immediate or long term health problems. Examples include paint stripper, pesticides, antifreeze, wood preservatives, furniture polish, and silver polish.

For practical identification, household products are often grouped into Cleaners, Car Products, Pesticides, Paints and Solvents, Other Household Products (batteries, fingernail polish, rubber cement).

Household hazardous products can cause problems both when they are being used and when they are discarded. Precautions should be taken to prevent exposure to dangerous products, especially by following recommendations for ventilation and preventing exposure to skin or eyes. Material Data Safety Sheets (MSDS), which detail use and disposal procedures, are available for most commercial products. Flinn Scientific has developed MSDS's for science teachers (P.O. Box 219 131 Flinn St., Batavia, IL 60510-0219, 321-879-6900.) Labels on household products provide much of the same information as the MSDS, although in less detail, and usually include a telephone number for more information.

Household Hazardous Waste Disposal

Unfortunately, most household hazardous wastes end up being thrown out with the regular trash, poured down the drain, dumped on the ground, or dumped down a storm sewer. These unsafe disposal methods are extremely harmful to the environment and can contaminate septic systems, surface water, or groundwater.

The only approved methods for disposal of most hazardous wastes are to recycle or reclaim them, to incinerate them in a hazardous waste incinerator, to neutralize the components chemically or biologically, or to solidify or stabilize the waste through chemical reaction before it is landfilled. This disposal is done at licensed hazardous waste facilities using the appropriate technology for each specific hazardous material. Recent studies indicate that people downwind of hazardous waste incinerators have developed a variety of health problems. Although there are no conclusive links, researchers suspect there are dangers associated even with the "approved" disposal of hazardous waste (Science News, 1993.)

Background Information

Household Hazardous Wastes

The Worst Offenders

Although *Waste Oil* is not a hazardous substance in the legal sense, it is a waste of special concern. Waste oil is the largest single source of oil pollution in U.S. waterways as most improperly disposed oil eventually finds its way into water sources. Oil discarded in landfills can leach into groundwater. Oil dumped on the ground or in storm drains can contaminate ground water and surface water.

Waste oil can be used as fuel in waste oil furnaces and can be recycled. In Maine, oil is collected by many businesses, auto service stations, and recycling centers. At some collection sites a fee may be charged for accepting waste oil.

Waste Paint accounts for 50-80% of the hazardous waste dumped by individual households. When disposed of improperly, paint can pose serious threats to human health and the natural environment. Latex paints are less hazardous than oil-based paints, but they still contain toxic substances and should be handled carefully. Reduction and reuse are the only practical methods available for disposing of waste paint, and these methods are generally available only for latex paints. Communities or civic groups can set up paint exchanges or collect latex paints for mixing and reusing. If those programs are not available, it is recommended to use up excess paint or give it to someone who can.

Most of the 2.7 billion household batteries used by Americans each year end up in household trash which is landfilled or incinerated. Many batteries contain heavy metals such as mercury, cadmium, lead, and zinc. Currently, there are no collection programs for household batteries. Large users like communication facilities and hospitals are required to collect and recycle mercuric oxide, rechargeable nickel-cadmium, and rechargeable small sealed lead-acid (used in emergency lighting) batteries.

What Else Can Be Done

The safest method of dealing with hazardous waste is not to create it in the first place. Many industries are finding alternatives to using hazardous materials in manufacturing. Consumers can find less toxic alternatives to many of the products they use. Schools as well should avoid hazardous products and find alternatives which will not harm the environment.

Taking Inventory: Before consumers can reduce their use of hazardous materials, they need to know what hazardous materials they have on hand and what hazardous waste they produce. An inventory of the hazardous substances in the home or at school is essential. At school, the hazardous materials inventory should be on file and is required to be updated annually. Often, miscellaneous cleaners or art materials are not counted in the school inventory. These can be added to make a complete listing of hazardous materials in the school.

Safety precautions should be taken during any inventory of hazardous materials. Students should be supervised by an adult. Do not open any containers; instead, use the information on the product labels. Do not shake containers. Be sure the materials are being stored properly. In school, consult a Material Safety Data Sheet for each chemical in the storerooms.

Purchasing: Buy products that are non-toxic, read the labels, and compare products. Use non-toxic alternatives, since specialized products are often unnecessary. Buy only the amount of material that you need for the job. Buy non-aerosol products since aerosols create mist which can be inhaled and can be harmful.

Product Use: Use products in well ventilated areas and avoid breathing fumes. Wear protective clothing. Never mix products, such as ammonia and chlorine bleach, two common chemicals in cleaning products, which when combined produce deadly fumes. Use only the recommended amount for each job.

Storage: Store household chemicals in a safe place and keep them away from children. Keep containers securely closed. Keep products in their original containers. If containers leak or corrode, place the old container and contents in another, leak-proof container.

Disposal: Use a product completely so there is nothing leftover to throw away. Donate leftover paints to a charitable group or another school, making sure the package is well labeled. Take used oil to an oil recycler (service station) near you. Collect rechargeable, ni-cad, and small sealed lead-acid batteries for recycling. Never pour harmful chemicals down the drain or on the ground.

The only appropriate disposal of most hazardous materials is through a licensed hazardous waste hauler at an approved facility. Schools and school districts can contract with a licensed hauler to remove hazardous materials for safe disposal.

Conclusion

Hazardous wastes have become a problematic component of the waste stream. Once created, they are expensive to dispose of and difficult to handle properly. Therefore, the best strategy for reducing the dangers of hazardous wastes in the home and in school is to avoid the purchase and use of products which contain hazardous materials. There are non-hazardous alternatives for most of these products.

To the extent that hazardous materials are necessary, they should be completely used, recycled, or disposed of through a licensed handler. Proper disposal of these materials will protect land, water, and people from pollution. We must all take responsibility to reduce our dependence on hazardous products and ensure the proper disposal of hazardous wastes.

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a. Household Batteries, January 1993
b. Household Hazardous Waste, January 1993
c. Waste Oil Recycling, January 1993
d. Waste Paint, January 1993

"Minimizing Household Hazardous Waste," Ginia Bellafante, Garbage Magazine, March/April 1990.

"The World Is Full of Toxic Waste. Your Home Shouldn't Be," Natural Resources Council of Maine. Augusta.

Appendices

I. Tools for Action	*181*
II. Instructional Resources	*193*
III. Organizations & Agencies	*197*
IV. Glossary	*201*

Appendix 1
Tools for Action: Letter Writing

Overview

These suggestions will help students put the skills they need to write effective letters into practice and get results. They focus on effective ways to ask for or report information, to state their opinion or to persuade others to their point-of-view, and to ask for help or support. Strong letter writing skills can help students in every action project in this guide, but the only way to really gain the skills is to do *the writing.*

Background

Writing letters can be an important strategy for making an action project really work. Businesses and manufacturers don't usually get letters from customers, and politicians use letters to measure public opinion. According to John Elkington in *Going Green: A kids handbook to saving the planet* (1990) if a company or politician gets just 20 letters on the same subject within a few weeks, they consider the subject a high priority. Expressing your concerns or needs clearly and convincingly helps get results. Getting classmates friends to join the effort makes the point even stronger.

A source of good ideas is *The Kid's Guide to Social Action: How to solve the social problems you choose - and turn creative thinking into positive action* by Barbara Lewis; Free Spirit Publishing, Minneapolis; 1998.

General Suggestions for Successful Letters

1. **K-I-S-S**: Keep it short and simple! As difficult as many students find reading and understanding, adults often don't read carefully or well. Busy people may not take the time to read a long letter. You should keep your letter less than a page.
2. The letter should focus on a single issue or request.
3. It is usually best to state who you are, what your project is, and what you want from the person (or how you'd like them to respond) in three or four sentences in the first paragraph.
4. Give more information about the project (or issue), and reasons why the person should help you (or believe you) in the next paragraph. This may not be needed in a simple letter requesting information.
5. Finish by restating the request or your major point in the last paragraph.
6. Use proper business letter form, including a return address and inside address. Using the school letterhead, or a special project letterhead (with return address) designed by students can make the letter stand out.

7. Be polite, even if you disagree with the person to whom you are writing.
8. Proofread the letter and make corrections before sending it out.
9. Expect a response to most letters (except a letter to the editor.) The response may agree or disagree with your opinion, but should not discount what you had to say. Letters from big manufacturers often say they have already thought about that issue and everything is OK. If there is not good proof, be prepared to write a follow-up letter to challenge their response!

Letter to the Editor

1. Look for guidelines printed in the magazine or paper you are writing to. They are usually found at the end of the letters section.
2. Use the greeting *Dear Editor:* and close it with *Sincerely, (your name).*
3. Send a type-written letter or letter from the computer if possible. Double-spacing makes it easier to read. If the letter is hand written, it is fine. Be sure to write neatly.
4. If you don't want the paper to use your name, ask the editor not to print it. But you must sign your name if you want the letter to be printed.
5. Never make an accusation about someone or a product without proof. Avoid libel (making someone look bad unfairly). You can be sued for making false statements!

Letter requesting information

1. Keep the letter very short.
2. Simply state your request and how you'd like the person to respond.
3. Plan ahead and allow at least a few weeks for a response.
4. Be sure the return address is clear so the response can get to you as quickly as possible.

Tools for Action; Publicity

Overview

Any project worth doing deserves to be promoted. You can let the world know about your project and about how other people can carry on your good work. Get your word out with newspapers, newsletters, flyers, exhibits, public meetings, or contests. Each ***pathway*** *lends itself to some form of publicity, and your project will have a wider reach and greater impact when you make it public. Presenting information to the public is also an excellent demonstration of learning or addition to a student's portfolio.*

Press Release

A press release is a written statement describing an event and is sent to newspapers, television, and radio news departments. Press releases may announce an upcoming event or a report an event after it has taken place. Notices of upcoming events may attract reporters to cover the story. A newspaper might print the release directly, or have a reporter use the information as the basis of an article of his or her own.

Send press releases to all your media contacts two or three weeks in advance of an event. The media are more likely to schedule coverage or to list the event in their calendar section. The release should be typed (or written on a computer) and double spaced if possible. If not, be sure it is easily readable. Try to keep it to one short page.

At the top of the press release indicate:

- "For Immediate Release"
- Date
- Contact person/Address/Phone number

The message of the press release should be clear and to-the-point. Be sure to include the five "W's": Who, What, When, Where, and Why details. Editors and reporters pay more attention to material that is catchy, humorous, or unusual. They are often more interested in press releases written by kids than those by adults.

Newspaper Article

Articles printed in the paper usually contain more information than press releases. You can use an article to report on an event yourself, or to convey information gathered during your project. Write the article and submit it to your local or regional paper. If you include a good photograph they may publish it with your article.

Like the press release, a newspaper story should include the five "W's" and have a relation to the wider community. Kids' stories that demonstrate their convictions about the environment and their success in an adult world are very compelling.

Many good articles begin by describing an individual's role in a project or effort and follow through with what that person had to endure, what she learned, or how he changed and influenced others. You can work information into the story and educate people in the process of telling about your project. Again, well-written stories by children are very appealing to the public, and to editors!

Flyer or Newsletter

Compile the information generated during your project into a flyer or a newsletter that you can distribute to parents, other students, or the public in general. Decide on a main theme for a newsletter and include short articles that relate to the theme. Devise a

single, clear message for a flyer and include supporting information. As in a Public Service Announcement, you should have the reader do something or respond with some specific action.

You can design an attractive layout for a flyer or newsletter on a computer. If you or the students don't have any experience with layout, consider asking a parent, or use other resources in the school district. The printed piece should be uncluttered with a clear message. Create a logo or banner that includes names, address, and phone number. Download clip art from the California Integrated Waste Management Board at www.ciwmb.ca.gov/mrt/wpw/wpinfoex/wpclpart.htm.

Public Meetings - School Board, Civic Groups, Church Groups

Present your project, your conclusions, or your problem to the people who can help support you or help spread the word. Let students do as much of the presenting as possible. However, they need to be well prepared to project a clear message and a make direct request. Visual aids, like video, slides, or charts help make information interesting, and can take a little pressure of the students. You should keep the presentation short, usually less than 15 minutes.

Describing your project or providing information is the easiest type of presentation. You should try to relate to the interests of the group, and give them information they can use or act upon.

It is more difficult to convince the school board or a civic group to support a proposal, especially if you are asking for money. In your presentation, answer the questions:

- Exactly what is the project trying to do?
- What support are you asking for?
- Why does the project deserve their support?
- What will they get as a result of the project?
- When will they see the results?

When you involve a wider community, more people will benefit from your work and they will become invested in the process.

Library Exhibit

An exhibit is a more passive method of spreading information, yet you can reach a large and receptive audience. School libraries and public libraries often have display tables available on a rotating basis. Arrange with the library director to schedule a time slot for your display. Plan ahead because library displays are often scheduled far in advance to coincide with special events or national observances.

Prepare a display of posters, brochures, photos, and/or models to get your information across. Often librarians like to have the displays relate to books or resources patrons can find in the library. Work with the librarian to have your display meet their guidelines and the needs of their patrons. Again, provide an opportunity for a viewer to respond or to take action. Provide enough brochures or handouts for the number of viewers anticipated.

Poster Contest

If your project has a slogan or a message you can express in a few key words, consider promoting a poster contest for students in your school or other schools in your district. A poster contest can generate a lot of interest, especially in younger students.

Send a flyer announcing the contest and explaining your basic message to the appropriate schools. Include the deadline, list of prizes, and where to send the completed posters. You might open the contest to the public (set age limits) and post the announcement in public places and put a notice in the paper.

Offer a prize, or prizes, for the best poster or poster/slogan combination. Students in your class can judge the posters. Display the winning posters in the school, post office, downtown shop window, or bank.

Tools for Action: Public Service Announcement

Overview

*Any **pathway** can lead to developing a public service announcement(PSA). This resource page describes how students can get their message, no matter what the topic or concern, out to the public. The public service announcement can be presented with live student actors for the school community, or recorded on audio and video tape. The PSA can be shown in schools and the community, and submitted to radio, television or cable stations to (possibly) be aired.*

Background

A public service announcement is a short statement which expresses concern for a problem and asks either directly or indirectly for the listener to respond in some way. PSAs related to *Pathways* action projects should convey the concern addressed by the class, present information about the subject, and/or convince the audience to join the effort with some specific action. Most broadcast stations allow free air time to non-profit groups (including schools.) They are very selective, however, so any PSA for broadcast should be very carefully planned and prepared. The PSA for broadcast should be designed for a wide audience; more than for your local community.

The usual time slots allowed for PSAs are for *exactly* 10, 20 or 30 seconds. Each station may have other special rules or guidelines for a PSA. Contact stations before planning the PSA so it can be designed properly.

WCSH-TV 6 Alive! offers a *Handbook for Public Service Organizations in Maine.* Call the Director of Communications for a copy (800) 464-1213.

Planning Considerations

1. The production and broadcasting of a PSA is in itself an ***action pathway,*** attempting as it does to have a certain impact on the listener. A PSA may also be a very good way to publicize and extend action you have already completed.
2. Decide at the outset what the production goal is for the project. If your PSA is designed for television air time, it will need to follow the directions in the Procedure for Developing a Successful PSA section very closely. If it is to be acted for the school community, it does not need to be as strictly tied to these instructions. Contact target stations to secure quidelines for submitting PSA's.
3. Consider taking a field trip to a radio station or TV studio to give students a better understanding of where the PSA will be going. Ask to listen to or see samples of other PSAs.

Procedure for Developing a Successful PSA

1. A public service announcement must be short and to the point. Therefore, the class should be able to answer two questions with five-word answers:
   - What do we want the audience to *know*?
   - What do we want the audience to *do*?

   The answers to these questions will help to focus the class energy throughout the project. The answers should both be contained in the PSA.
2. There are four different styles to consider:
   - Informational - tells the audience directly what they should know and do;
   - Humorous - may be entertaining, but the message in the PSA must be clear;
   - Testimonial - features one or two individuals who convey a personal message;
   - Dramatic - attempts to show an important message, rather than tell.
3. The group should always write a complete script for a PSA, describing the sound and image to be included in the segment. (A PSA designed for radio broadcast will only need a text of spoken words.)
4. A PSA should be no longer than 30 seconds. It is okay if the segment is slightly shorter than this, but it cannot be any longer. If a narrator were to talk continuously at a normal speed in the PSA, he or she could fit approximately 65 words. This should be seen as an absolute maximum number of words for the script.
5. When the script is complete, try staging the PSA with student actors several times. Ask other students or teachers to watch the PSA. Does it:
   - make sense?
   - catch the attention of the audience? (A video must have powerful visual images.)
   - provide important information?
   - motivate the viewer to action?
6. Remember that if music is to be included in the PSA, *it must not be copyrighted.*

Producing the PSA

There are many different avenues for getting a PSA produced:

1. Use live student actors and present the message to the school community. If the class develops more than one PSA, this may be the best idea. Since each segment is only 30 seconds long, however, it may be best to present the announcement during some other event (e.g., at lunch time, before a school assembly). Sound-only PSA's can be read to the entire school during daily announcements.
2. Produce the PSA with an audio or video recorder. The tape can then be aired in the school or sent to other schools. This will require equipment and some significant production time, but is a valuable process. Editing capability will be very helpful.
3. Produce the PSA on video and submit it to your local cable operator to be shown over the public access channel.
4. Submit a completed script or finished audio or video tape to radio and televisions in your local area. Most broadcasting stations accept PSAs; however, they may wish to produce the segment themselves.

Tools for Action: Pushing for Policy Change

Overview

Students can change their behavior, create less waste, or work on a recycling program, but what can they do if they discover that a big part of their waste problem results from the way the school operates or the things it buys? Kids and teachers can't change school procedures by themselves. It may take a change in school policy to make a real difference. For this, they need the support of the school administration and the school board.

Political action isn't easy. Sometimes students and teachers need to push the system and help the "powers that be" understand how they can help reduce waste and work toward a sustainable future. Kids who present their ideas to make the world a better place are very compelling in front of the school board or town council. These "Pushing for a Change" suggestions can help them pull the right strings and push their idea through.

Ten Steps for Taking Action

No matter what your problem or project , there are a few steps that will help you organize a successful project. Here we have adapted the ten steps described by Barbara Lewis in *The Kid's Guide to Social Action* (1998).

1. *Identify the issue.* Choose a problem that is important to the whole group and everyone can support. Don't just consider a problem that is easy to solve, but at the same time don't choose something that would overwhelm the group.
2. *Research the problem.* Find out as much about the issue a possible. Use books, newspapers, and experts. Survey people to see how they feel about the issue, talk with public officials on the phone or in person.
3. *Brainstorm possible solutions and strategies.* Brainstorming is a creative group process. Think of all the different possibilities and discuss them to refine your plan of action. Choose one or a few solutions.
4. *Get support for your project.* Find people who agree with you and get their support, build a coalition. Talk with parents and relatives, neighbors, other students, town officials, state agencies.
5. *Identify the opposition.* Who has different opinions or is against your solution? Seek out your opponents and try to win them over. Listen to them to understand their side and appreciate their opinions. You will have begun this step as part of step 2 above. Perhaps your conversations with opponents will cause some adjustments of the solutions and strategies chosen at step 3 above.
6. *Advertise.* The media are usually enthusiastic about student action. Use press releases and public service announcements to express your concerns or get your message out.

7. *Raise money.* This is not always necessary, but often having money can help you accomplish parts of the project much easier.
8. *Carry out the solution.* After getting all the plans in place, get to work. List the steps, decide who is responsible for each, and when each step will happen.
9. *Evaluate the progress.* How is the plan working? Are there things you should change? Do you need to talk to more people? Make it work!
10. *Don't give up.* Don't just accept everything people say about why your plan won't work. Keep at it until you find a solution that *will* work. If the issue is important, stay with it!

Changing School (or District) Policy

School policies are established by the School Board (School Committee, Joint Board, etc.) The Board makes the decisions that keep the schools running and control how the money is spent. Yet, if your students have a plan to get the school to reduce waste by 50% , you probably shouldn't go straight to the Chairman of the Board. You need to go through channels to fit in with the system before you can expect to change the system.

Another complication is that school administrative structure varies widely and the procedures can be very different. You should talk with administrators and attend Board meetings to get a first-hand picture of how things operate in your system. The following steps are general suggestions for developing an approach to making significant changes in the way things are done in most schools.

Research the issue

1. If a school policy (e.g. using disposables in the cafeteria) is at the heart of the problem, have the Principal discuss the policy with the students. Be sure the students understand why the policy is in place, how long it has been the policy, and what he or she sees as the obstacles to changing the policy.
2. If a school practice (e.g. buying non-recycled paper) is at the heart of the problem, have the Principal describe the reasons for the practice, and who makes the decisions to change it.
3. Have the Principal describe how students can influence school policy or practice.

Develop the action plan with the students

1. Prepare a written description of the plan:
   - What is the problem? How do you propose to solve the problem?
   - Why is this the best solution?
   - What are the obstacles you anticipate?
   - How can these be addressed?
   - What is the time frame for each step?
2. Anticipate all costs involved in putting the plan into action. Where might those funds come from?
3. Involve the Principal in the planning, or at least keep him or her informed about the project. Ask the Principal for advice about how to get Board approval.
4. Communicate with parents and get their support for the plan.

Schedule an appearance at a regular Board meeting

1. With the Principal's support, make arrangements with the Superintendent to have your issue put on the agenda at a regular meeting of the School Board.
2. Have students write a letter in their own words to the Chairman of the Board outlining their concerns and how they see the problem. This direct link to the Board from well informed students can be very compelling, and will alert the Board members to the sincerity of the appeal from kids and the care with which the proposal is being made.
3. Prepare your presentation for the Board.
4. Have parents attend the meeting to demonstrate community support for your proposal. Talk with the opposition to bring them to your way of thinking, or make some compromises to gain wider support.

Pushing for a Change

Meet with the School Board

1. Have two or three students attend and make parts of the presentation. Consider making the presentation as dramatic, lively, and concrete as possible. The presentation should be less than 15 minutes long.
2. You should clearly state the problem, your solution, and why your solution is the best alternative.
3. Conclude by asking the Board for some specific action (to review and change policy, approve the project, give support, appropriate money, etc.)

Follow through

1. Write a letter of appreciation to the Board and send copies to the Principal and Superintendent.
2. If the plan was approved, follow the procedures you proposed. Carefully stick to the time frame you outlined.
3. If the plan was not approved, help students appreciate the democratic process and the reasons why the Board did not accept the proposal. Discuss alternative actions. Consider a publicity campaign to further explore the issue.
4. Publicly recognize the contributions of the students, Principal, and Board at any event for the project or in written material.

Proposing or Changing a Local Ordinance or Law

After you have decided on your issue and researched the problem, you might decide that the solution is to pass a new law, or change an old one. But before tackling ordinances and laws, you need to know how your local government works. Towns and cities in Maine have very different procedures, and might require different strategies. Call the town clerk to find out who you should talk to about the process in your town. Use the information you get about local government to plan who you'll contact with your proposal and learn how much work it will be to get the proposal adopted.

Before you make your proposal to the local government, do all your homework (research) to make your case. A petition is not usually required to initiate the process, but you can make a very strong statement if you have your proposal supported by a petition with many signatures. When you are ready to get the town wheels moving, follow these steps.

1. Contact the appropriate town official. Call, write, or meet with the selectmen, town manager, town council, planning committee chairman, clerk, or whoever can help you get started. Explain the issues and solutions, make your case. Get more information about procedures, opposition, legal problems, etc. Have students involved as much as possible.
2. Build your coalition of support and attend meetings when the issue is discussed. Provide information from your research as needed.
3. The town will decide if there is a need for your proposed law, investigate to be sure it doesn't conflict with existing laws, and draft the ordinance in legal language.
4. The proposed ordinance may be presented at a public hearing, or a town meeting. Plan to testify or present your case as you would to the school board.
5. The town will act officially to approve or deny the proposal. This may be through the selectmen, council, or town meeting.

Town ordinances or laws proposed by students will receive the same (or greater) scrutiny as any other proposal. Your success will depend on your research and the coalition of support in the community. This can be a very difficult process, yet it can be one of the most rewarding for students and teachers alike.

Appendix II
Instructional Resources

There are at least two inventories of outstanding instructional resources in the field of solid waste management:

A Resource Guide of Solid Waste Educational Materials
Federal Document #EPA530-B-97-004
RCRA Information Center (5305W)
U.S. Environmental Protection Agency
401 M Street S.W.
Washington D.C. 20400
e-mail: rcra-docket@epamail.epa.gov

Compendium for Integrated Waste Management
California Integrated Waste Management Board
Schools Section
8800 Cal Center Drive
Sacramento, CA 95826
(916) 255-2826

The Resource Guide is a 35-page compilation of nearly 50 solid waste-related educational activities published in 1997. Commentary is brief and exclusively positive. A variety of types and formats of materials are included, including 7 videos and 9 websites. Note email address above.

The Compendium, published in 1993, is an extensive evaluation of waste management curriculum materials. Reviews are critical, detailed, and nicely organized, and samples of student activities are included. Extremely useful, but getting out of date. A revised edition is in the works. We advise telephoning the Waste Management Board for a (free) copy of the 1993 edition and to inquire about the revision.

40 Low Waste/Low Risk Experiments for High School Chemistry
J. Weston Welch Publishers,
Portland, ME; 1994
Contact: David Dougin
ChemSafe Consulting, Inc.
P.O. Box 332
Mapleton, ME 04757
(207) 764-5387

This manual was developed to reduce both student exposure to hazardous chemicals and the quantity of hazardous waste generated in chemistry experiments. The scope of the experiments and quality of the outcomes are comparable to traditional methods. Non-hazardous substitution and microscaling are utilized to achieve meaningful quantitative and qualitative results. The manual is designed to interface with existing textbooks. Student text $9.95, Teacher text $11.95.

American Plastics Council
1801 K St. NW
Suite 701L
Washington, DC 20006
(800) 2-HELP-90
www.plasticresource.com
Waste Management Video, hands-on plastic kit

Canadian Environmental Education Catalogue
The Pembina Institute of Appropriate Development
P.O. Box 7558
Drayton Valley, Alberta T7A 1S7
Canada
(403) 542-6272

This is a comprehensive catalog with 34 environmental topics. It covers books, videos, films, posters, games, music, magazines from the U.S. and Canada; short descriptions of each resource with notes on focus area and suggested uses, reading level, ordering information. $10 (plus $10 shipping to the U.S.)

Coastal Clean-Up
The Center for Marine Conservation
1725 DeSales Street NW
Washinton, D.C. 20036
(202) 429-5609
www.cmc-ocean.org/cleanupbro.
In Maine Contact:
Maine Coastal Program
Statehouse Station 38
Augusta, Maine 04333
(800) 662-4545
www.state.me.us/spo/

A national effort. In early October groups of adults and children volunteer to patrol sections of coastal shoreline to pick up litter and all kinds of trash. The varieties of material are catalogued and weighed, and the information is compiled and used to identify the most serious source of ocean trash and source reduction steps that might be taken. Often conducted in conjuction with Coastweek and Beachweek.

Composting: Wastes to Resources
Leader's Guide to Community Action
Recycling: Mining Resources from Trash
Waste Management Fact Sheet Set
What About Waste
Contact: Resource Center-GP
Cornell University
7 Business and Technology Park
Ithaca, NY 14850
(607) 255-2080
http://www.cce.cornell.edu/publications/catalog.html

Fact sheets on plastics, composting, incinerators, options for waste prevention. Order # 174WMSET, $10.25. *What About Waste* is a booklet describing waste issues. Order # 147WAW, $3.00. Recycling: Mining Resources from Trash includes 5 posters (aluminum, glass, paper, plastic and Watching Your Waste.) Order # 174RMT, $8.00. Leader's Guide order # 159S115, $2.85. Composting includes 2 posters: How Does Composting Work? and Best Compost. Order # 147CWRF, $8.00.

Crafts from Trash
Wisconsin Dept. of Natural Resources; 1984
Contact: Wisconsin Dept. of Natural Resources
Bureau of Solid Waste Management, Bureau of Information and Education
Madison, WI 53703

Instructional Resources

Earth to Kids, Consumer Reports TV (video)
Contact: Consumer Reports TV
101 Truman Ave.
Yonkers, NY 10703
(914) 378-2000
This is an interesting video which compares the environmental impact of brand-name products. It gives students a very clear idea of what to look for in purchasing products, and helps them make decisions about what they might "need" or might be able to do without to help protect the environment.
www.consumerreports.org

E: The Environmental Magazine
Contact: Earth Action Network
Environmental Media
P.O. Box 5098
Westport, CT 06881
(800) 368-3382
E Magazine is an award-winning clearinghouse of environmental information and commentary. It offers teachers and students thorough and thoughtful articles and additional resources for more information. Bimonthly (8 issues) $14.94/year.

The Environmental Shopper
Contact: Pennsylvania Resources Council
3606 Providence Rd.
Newton Square, PA 19073
(610)-353-1555
www.prc.org
This instructive booklet is a list of products that use recycled packaging, $2.00.

Environments and Ecology Catalog
Cornell University
Audiovisual Resource Center
8 Research Park
Ithaca, NY 14850
(607) 255-2080
Annotated list of films, filmstrips, tapes, and publications
http://www.cce.cornell.edu/publications/catalog.html

Harmony Catalog
Broomfield, CO 80021
Harmony is a catalog retailer of "products for a healthy planet." Items include energy saving devices, products made from recycled materials, clothing made from organically grown cotton.

Keep It Green Game
Environmental Media
P.O. Box 99
Beaufort, SC 29901
(800) 368-3382
www.envmedia.com
Keep It Green is a cooperative learning game of environmental awareness for children and adults. Players attempt to reach Planet Earth while it is still green and living. Those who reach the planet first are encouraged to return to help others. Game $24.95, manual $5.95. Also offers over 500 EE games: supplies through environmental media catalog.

The Kid's Guide to Social Action
by Barbara Lewis; Free Spirit Publishing, Minneapolis; 1998
Contact: Free Spirit Publishing, Inc.
400 First Avenue North, Suite 616
Minneapolis, MN 55401
(612) 338-2068
The Kid's Guide to Social Action is subtitled "How to solve the social problems you choose - and turn creative thinking into positive action." It contains inspiring accounts of how kids and school classes have taken action steps to effect real change in their communities and beyond. Some of the material in **Appendix I: Tools for Action** is adapted from *The Kid's Guide.*

The Lorax (video)
Contact: Michigan Media
University of Michigan
400 Fourth St.
Ann Arbor, MI 48103-4816
Video for all ages. This is an animated Dr. Seuss film about the destruction of natural resources and resulting pollution. Available for rent.

Maine State Planning Office
Waste Management Section
Statehouse Station 38
Augusta, Maine 04333
(800) 662-4545
www.state.me.us/spo/wm&r/
The nicely organized website is full of pertinent fact sheets and reports and lists dozens of available videos.

Marz Barz, songs for kids of all ages (music cassette)
Bob Reid and Friendz, Blue Bear Records, 1989
Contact: Bob Reid
P.O. Box 505
Aptos, CA 95003
(408) 662-0164
Many engaging songs including "Garbage", "Do You Care About Earth?", "Habitat."

Obvious Implementions Corporation
www.obviously.com
Good basic information. Politically active, down to earth, and grass roots. Links to other useful sites such as Recycling Manager, published by the Global Resources Network. Go there! In particular see obviously.com/recycle (The Internet Consumer Recycling Guide) and obviously.com/junkmail.

The Official Recycled Products Guide
American Recycling Market, Inc.
P.O. Box 577
Ogdensburg, NY 13669
(800) 267-0707
The guide is a directory of manufacturers and vendors of recycled products. It comes as a monthly newsletter or as an online database by subscription.

Pollution: Problems and Solutions
NatureScope Teacher's Guide
National Wildlife Federation
1400 16th Street, NW
Washington, DC 20077-9964
1-800-2MCGRAW
www.nwf.org
The NWF is a multi-issue environmental organization, publishes Ranger Rick Magazine for children, and Ranger Rick's NatureScope, an environmental activity series for teachers. The NatureScope issue on Pollution: Problems and Solutions addresses solid waste, air and water pollution, and offers suggestions for action steps.

Recycling: Games, Science Equipment, and Crafts From Recycled Materials
by Robin Smith; Houghton Mifflin, 1976

Recycling Information Kit
Consumer Information Center
P.O. Box 100
Pueblo, CO 31002
Ask for recycling information for children.

Recycling: Waste Into Wealth (video)
Bullfrog Films
Oley, PA 19547
Intermediate and Advanced. Includes steps for starting a recycling program.

Solid Thinking About Solid Waste (curriculum guide)
Kraft General Foods, 1992
Dept. of Environmental Policy, Kraft General Foods
Three Lakes Drive
Northfield, IL 60093
847-646-2000
www.wp.kraftfoods.com/
The *Solid Thinking* curriculum is an excellent resource for middle school classes. It involves a research-based approach with students doing important investigations. Highly recommended for groups who what to do a more thorough analysis of their waste disposal issues.

The Solid Waste Mess: What Should We Do About It!
North American Association for Environmental Education
Washington, D.C.
(202)-884-8912
NAAEE is an international membership organization committed to the professional development of environmental educators throughout the world.

The Stop Junk Mail Book
by Dorcas S. Miller; Georgetown Press, Georgetown, ME
Contact: Dorcas Miller
RFD 9
Augusta, ME 04330
(207)-582-5600
This book contains many strategies for reducing unwanted mail; 32 pre-printed postcards to stop junk mail.

Too Much Trash! Computer Linked Research Program
National Geographic Kids Network
Contact: Karol Media
P.O. Box 7600
Wilkes-Barre, PA 18773
(717) 822-8899
The NGS Kids Network is a coordinated national research project which links a classroom to a regional research team and unit scientist through a computer network. The Too Much Trash? project has students inventory the school waste stream and provide data to the research team. Students analyze and compare data from other classes in the team, then receive a national profile using all the NGS teams' data. The teaching guide helps organize action projects for the school. A free preview copy is available. The kit costs $375 and there is an annual subscription fee for the research program. Grades 4-6.

Trash Conflicts: A Science and Social Studies Curriculum on the Ethics of Disposal
by Amy Ballin, Jeffrey Benson, and Lucille Burt; Educators for Social Responsibility, 1993
Contact: Educators for Social Responsibility
23 Garden St.
Cambridge, MA 02138
(800) 370-2515
Trash Conflicts promotes a deeper understanding of the impact of waste production and disposal. Through science-based experiments, research and analysis, role plays, and discussions students learn about the nature of garbage, disposal methods, consumer behavior, toxic waste, and the political process surrounding trash disposal. Grades 6-8.
http://www.benjerry.com-esr

U.S. Environmental Protection Agency
Office of Solid Waste Management
401 M st. WS
Washington, D.C. 20460
(202) 382-4627/ (800) 424-9346
Region 1 Office
JFK Federal Building
Boston, MA 02203
(617) 573-9670
Offers a combination of technical and general information. A Catalog of Hazardous and Solid Waste Publications, free on request.

Waste Away
The Vermont Institute of Natural Science
RR2, Box 532
Woodstock, VT 05091
(802) 457-2779

In Maine contact:
The University of Maine Cooperative Extension
5741 Libby Hall
Orono, ME 04469-5741
(207) 581-3188
www.umext.maine.edu/
An exciting mini-course for grades 4-6, which uses hands-on activities, experiments, and simulation games. With the help of teachers and parent volunteers, students spread their knowledge to their schoolmates, families, and communities. The objective is to encourage a lifestyle that includes the "3 R's:" Reduce, Reuse, and Recycle. Published in 1989.

Waste Watch Center Publications
Contact: Dana Duxbury and Associates
16 Haverhill St.
Andover, MA 01810
(978) 470-3044
Considered one of the leading sources of information about household hazardous waste management information in the country. Request publication list.
www.wastewatch.org

Woodsy's Wastewise (slide set)
Audiovisual Resource Center
8 Research Park
Cornell University
Ithaca, NY 14850
(607) 255-2080
http://www.cce.cornell.edu/publications/catalog.html
This is a slide set and activity booklet that features Woodsy Owl and shows kids how to reduce waste.

Worms Eat My Garbage
by Mary Appelhof
Flower Press; Kalamazoo Michigan; 1982.
Excellent basic book on composting with worms and constructing worm bins.
1997 Revised Edition, 162 pages $15.45 post paid. Also sells redworms and has classroom curriculum books on composting activities.
10332 Shaver Road
Kalamazoo, MI 49024
(616)-327-0108

Appendix III Organizations & Agencies

ADVO Systems, Inc.
List Services Manager
239 West Service Road
Hartford, CT 06120-1280
(860)-520-6600
www.advo.com
ADVO maintains address lists which are sold to direct mailing operations. To reduce "junk mail" contact ADVO and ask to have your name (and any variations) removed from the list. See also Mail Preference Service.

The Aluminum Association
900 19th Street, NW
Washington, DC 20006
(202) 862-5100
www.aluminum.org
Provides public information and Packaging Programs. Publications include Fact Sheets on Aluminum (Aluminum Recycling, Aluminum Food and Beverage Cans, Aluminum Foil and Packaging). Video available, Aluminum Recycling: Your Next Assignment, free.

American Paper Institute
Paper Recycling Committee
260 Madison Avenue
New York, NY 10016
(212) 340-0600
Publications include free paper recycling pamphlets and brochures including: 12 Facts About Waste Paper Recycling, How to Recycle Waste paper and Paper Recycling and It's Role in Solid Waste Management. Also posters, and free loan video on paper recycling.

California Integrated Waste Management Board
8800 Cal Center Drine
Sacramento, CA 95826
(916) 255-2385
www.ciwmb.ca.gov/wpe/schools/edasst.htm
Educational materials and link to a variety of information sources from our largest state's waste management agency. Extensive Waste management model graphics at ciwmb.ca.gov/mrt/wpw/wpinfoex/wpelpart.htm.

The Chewonki Foundation
485 Chewonki Neck Road
Wiscasset, ME 04578
(207) 882-7323
www.chewonki.org
Chewonki offers environmental education programs for schools, Maine Coast Semester (11th grade semester focusing on environmental issues and natural science), wilderness expeditions, summer camp, teacher resources.

Citizen's Clearinghouse for Hazardous Waste
P.O. Box 926
Arlington, VA 22216
Focus on grassroots organizing, public awareness, and legislative involvement; publications include Household Hazardous Waste Fact Pack ($2.00), Recycling: The Answer to Our Garbage Problems ($8.98).

The Conservation and Renewable Energy Inquiry Referral Service
P.O. Box 8900
Silver Spring, MD 20907
Offers recycling and conservation information for school children, write for information.

Environmental Action Coalition
625 Broadway
New York, NY 10012
(212) 677-1601
www.enviro-action.org
The EAC provides information on a variety of issues including waste batteries, battery legislation, and pilot collection programs. They respond to requests for specific information on environmental effects of batteries, source reduction, current legislation, market conditions and also provide information on recycling.

Environmental Defense Fund
257 Park Avenue South
New York, NY 10010
(800) CALL-EDF
www.edf.org
EDF focuses on legislative efforts in many environmental areas and provides information on recycling for citizens. Extensive website even has an introduction to web browsing for kids! Go to www.edf.org/earth2kids/walking.

Environmental Hazards Management Institute
P.O. Box 932
Durham, NH 03824
(603) 868-1496
www.ehmi.org
The Institute develops educational materials for the management of household hazardous waste including recipes for alternative cleaning products. Also home composting and recycling; home environment such as air quality.

Environmental Newsletters
11906 Paradise Ln.
Herdon, VA 20171
(703) 758-8436
Waste reduction tips bi-monthly newsletter- contact for free sample.

Flinn Scientific
P.O. Box 219
131 Flinn Street
Batavia, IL 60510-0219
(630) 879-6900
Flinn has developed MSDS (material safety data sheets) for science teachers. Call for information.

Glass Packaging Institute
1627 K St. NW
Suite 800
Washington, DC 20006
(202) 887-4850
www.gpi.org
Publications include Glass Recycling: Why? How? and The Great Glass Caper, a teaching kit designed to teach about benefits of recycling glass containers, newspapers and aluminum cans.

Dr. Marquita Hill
Department of Chemical Engineering
5737 Jenness Hall
University of Maine
Orono, ME 04469
(207) 581-2277
Dr. Hill develops information and teaching materials promoting Pollution Prevention.

Incinerators - Maine's major Incinerators
Maine Energy Recovery Co. (MERC), Biddeford
(207) 282-4127
Mid-Maine Waste Action Corp., Auburn
(207) 782-7716
Penobscot Energy Recovery Co. (PERC), Orrington
(800) 698-0859
Regional Waste Systems (RWS), Portland
(207) 773-6465

Kids Against Pollution
Contact: Christine Woods
1-(315)-845-8597
A network of children's groups active in environmental clean-up.

Kids for Saving Earth
Contact: Tessa Hill
P.O. Box 42118
Plymouth, MN 55442
(612) 559-1234
KSE is an organization for helping kids everywhere find ways to protect the environment. Membership (no cost, tax deductible donations accepted) receive newspaper of ideas and activities from KSE members worldwide. School groups (pre-K-HS) are encouraged to form a KSE Club. To register, the group needs an adult advisor and a completed registration form (available from KSE).
kidsforsavingearth.org

Landfills - Maine's Major Landfills
Crossroads Landfill, Norridgewock
(800) 562-7779
Hatch Hill Landfill, Augusta
(207) 626-2440
Sawyer Environmental Services, Bangor
(207) 947-4997
Tri-Community Recycling and Sanitary Landfill, Caribou
(207) 473-7840

League of Women Voters
1730 M Street, NW
Washington, DC 20036
The League of Women Voters is very active in recycling and waste issues for communities. Local chapters also have information.

Mail Preference Service
Direct Marketing Association
P.O. Box 9008
Farmingdale, NY 11735
The Mail Preference Service maintains address lists which are sold to direct mailing operations. To reduce "junk mail" contact them and ask to have your name (and any variations) removed from the list. See also ADVO Systems.

Maine Audubon Society
Gilsland Farm, 118 U.S. Route 1
P.O. Box 6009
Falmouth, ME 04105
(207) 781-2330
www.maine.audubon.org
Maine Audubon's Gilsland Farm Environmental Center houses the Teacher's Resource Center which offers information and curriculum materials, workshops, and teacher support. MAS also offers school programs and seasonal walks at several sanctuaries, field trips and world tours, and is an advocate for habitats and wildlife issues.

Maine Environmental Education Assn.
P.O. Box 9
Wiscasset, ME 04578
(207) 882-7323
MEEA is a statewide membership organization serving the environmental educators of Maine with mini grants, annual awards, and an annual conference. It is a state affiliate of the New England Environmental Education Association and the North American Association of Environmental Education.

Maine Resource Recovery Assn.
Local Government Center
Community Drive
Augusta, ME 04330
(207) 623-8428
Promotes professional solid waste management in Maine and works to further the development of recycling and resource recovery in a cost-effective, environmentally sound manner.

Maine State Planning Office
Waste Management Section
Statehouse Station 38
Augusta, Maine 04333
(800) 662-4545
www.state.me.us/spo/wm&r/
The nicely organized website is full of pertinent fact sheets and reports and lists dozens of available videos.

McDonald's Educational Resource Center
McDonald's Corporation
Box 8002, Dept. L-90
St. Charles, IL 60174
Publication available: "Environmental Action Pack," for grades 3-6.

National Audubon Society
700 Broadway
New York, NY 10003
(212) 979-3000
(800) 274-4201 for membership information
www.audubon.org
National Audubon is a membership organization addressing environmental concerns. They publish Audubon magazine 6 times/year and develop community information and educational materials.

National Consortium for Environmental Education and Training
University of Michigan
School of Natural Resources & Environment
Dana Building 430 E. University
Ann Arbor, MI 48109-1115
(734)-763-1312
NCEET provides many teacher materials for planning and organizing environmental education activities. (Toolbox: Getting Started, $9.95, National Survey of EE teacher Education, $6.95.)

National Science Teachers Association
1840 Wilson Blvd.
Arlington, VA 22201-3000
(703) 243-7100
www.nsta.org
NSTA is a national membership organization for science teachers. They are developing the Project on Scope, Sequence, and Coordination, an effort to redesign science education in American schools.

Organizations & Agencies

National Solid Wastes Management Association
4301 Connecticut Ave. NW
Suite 300
Washington, DC 20008
(202) 244-4700
www.envasns.org
Offers several colorful pamphlets and fact sheets on solid waste topics.

National Wildlife Federation
1400 16th Street, NW
Washington, DC 20077-9964
(800)-822-9919
www.nwf.org
The NWF is a multi-issue environmental organization, publishes Ranger Rick Magazine for children, and Ranger Rick's NatureScope, an environmental activity series for teachers. The NatureScope issue on Pollution: Problems and Solutions addresses solid waste, air and water pollution, and offers suggestions for action steps.

Natural Resources Council of Maine
271 State St.
Augusta, ME 04330
(207) 622-3101
NRCM is a non-profit environmental advocacy group that lobbies for recycling and source reduction issues, participates in administrative rule making and hearings, and adopts positions on various recycling, household hazardous waste and waste management issues.

North American Association for Environmental Education
P.O. Box 400
Troy, OH 45373
(937) 676-2514
www.naaee.org
NAAEE is an international membership organization committed to the professional development of environmental educators throughout the world.

Northeast Recycling Council
139 Main St., Suite 401
Brattleboro, VT 05301
(802) 254-3636
www.nerc.org
NERC is a non-profit, non-partisan agency established by the ten northeastern states. Its primary focus is the development of regionally consistent and compatible policies and programs that are intended to stimulate markets for recyclable materials.

Plastic Loose-Fill Producers Council
(800) 828-2214
The Council lists the locations and phone numbers of local collection points of loose-fill packing material (foam "peanuts"). The sites are usually businesses which do a lot of shipping and mailing like Mail Boxes, Etc.

Stop Junk Mail Assn.
Michael Esh
3020 Bridgeway, Suite 150
Sausalito, CA ZIP CODE EXEMPT
(800) 827-5549
The SJMA offers a kit ($17.50) to help stop your junk mail. When you order the kit, the SJMA has your name(s) removed from the national direct mail lists and sends you materials to help you notify all other sources of junk mail. It also offers suggestions to stop delivery of junk mail by the post office. The SJMA is involved with lobbying in Washington, DC to reform post office practices of selling addresses for direct mail.

U.S. Deptartment of Energy
Office of Industrial Technology
www.doe.oit.gov/
Well organized information on recycling efficency, energy technology, batteries, etc.

U.S. Environmental Protection Agency
Office of Solid Waste Management
401 M St., SW
Washington, DC 20460
(202) 382-4627 / (800) 424-9346
Region 1 Office
JFK Federal Building
Boston, MA 02203
(617) 573-9670
Offers a combination of technical and general information. A Catalog of Hazardous and Solid Waste Publications, free on request.

U.S. Postal Service
www.usps.gov/environ/webpages/contact.htm
At this site are the addresses of the Post Office's national and regional environmental policy managers.

University of Maine Cooperative Extension
5741 Libby Hall
Orono, ME 04469-5741
(207) 581-3188
www.umext.maine.edu
Best source in Maine for help with composting or with teaching "Waste Away" curriculum materials. Go to website for access to County Offices.

Wise Recycling Co.
139 Sebethe Dr.
Cromwell, CT 06416
(860) 632-1025
Offers a free comic book on can recycling and a color-your-own poster on recycling.

Waste Watch Center
Contact: Dana Duxbury and Associates
16 Haverhill St.
Andover, MA 01810
(978) 470-3044
www.wastewatch.org
Considered one of the leading sources of information about household hazardous waste management information in the country. Request publication list.

World Watch Institute
1776 Massachusetts Ave., NW
Washington, DC 20036
(202) 452-1999
www.worldwatch.org
World Watch tracks key indicators of the earth's well being by monitoring global changes in climate, forest cover, population, poverty, food production, water resources, biological diversity, and other major trends. World Watch Papers are published 6/year, each focuses on a particular environmental issue. "Discarding the Throwaway Society" World Watch Paper 101; by John E. Young; January, 1991.

Appendix IV Glossary

acid rain - precipitation which is made acidic by chemical reaction with pollutants in the atmosphere

aerobic - decomposition that takes place in the presence of oxygen

anaerobic - decomposition that takes place in the absence of oxygen, usually producing methane and foul odors

ash - the solid residue left when combustible material is burned

ashfill - a special secure landfill used for the disposal of incinerator ash

bauxite - the raw material from which aluminum is extracted; aluminum ore mined from the earth

biodegradable - the term describing a substance which can be broken down into simpler compounds by decomposing organisms

bottle bill - legislation in effect in ME, MA, CT, VT, NY, DE, MI, IA, OR, and CA which requires a deposit on beverage containers, the deposit is returned to the consumer when the container is redeemed at a collection site; incentive to return containers for recycling

bottom ash - ash that drops out at the bottom of an incinerator and is disposed (usually in a secure landfill)

close the loop - completing the recycling process by buying products made from recycled materials

composite liner - a landfill liner made of both plastic and soil components

compost - the product of composting; a mixture that consists largely of decayed organic matter which is a useful soil additive

composting - a waste management strategy where organic wastes are partially decomposed by aerobic bacteria and fungi, producing a useful soil additive; fourth priority in the waste management hierarchy

consumer goods - products sold to the end-user; the products usually sold in stores

consumption - the use of resources (either materials or energy)

convenience foods - single-serving or highly processed foods designed to be easy-to-use; often create a large amount of packaging waste per serving

corrosive - the quality of certain substances which are either extremely acidic (pH below 2) or basic (pH above 12.5) capable of dissolving or breaking down other substances, particularly metals, or causing burns on skin

cullet - crushed glass, a step in the process of recycling glass

curbside pickup - a service to residents and businesses where a trash hauler collects waste and/or materials separated for recycling and left at the curb

decomposition - the natural process of recycling of organic matter by breaking down into its constituent parts

design for disassembly, design for recycling - a concept in product design where plans are made for ease of disassembly or recycling at the end of the product's life

disposable product - a product designed for single-use or short life span, e.g. disposable diapers, ball point pens

durable product - a product that is designed to have an extended life span; opposite of disposable

elbow grease - technique used in cleaning typified by physical effort, e.g. scrubbing, rather than using chemical products

environmental cost - a calculation of the effect that the production of a product has on the environment, usually considers the effect of resource depletion and pollution in extraction, manufacture, transportation, use and disposal

EPA (U.S. Environmental Protection Agency) - the federal agency charged with enforcement of all federal regulations having to do with air and water pollution, radiation and pesticide hazard, ecological research, and solid waste disposal

fly ash - airborne particles produced during incineration; usually filtered before the smoke is released

green products (green consumer choices) - items which have a lower environmental cost than traditional products

groundwater - water stored in the porous spaces of soil and rock underground; source of water in many drinking water wells

hazardous material - chemical or product that poses a significant threat to human health and/or the environment in use, transportation, or disposal

hazardous waste - waste that is dangerous to human health and/or the environment; defined as waste that is toxic, reactive, ignitable, corrosive, or radioactive

heavy metals - elements used in the manufacture of certain products which are toxic such as lead, mercury, and arsenic, among others

high-speed digestion - an experimental waste management process in which the natural composting process is accelerated

Glossary

humus - partially decayed organic material produced in a compost heap; contains humic acids

hydrapulper - a large blender used to shred paper as it is processed into pulp and ultimately remanufactured into recycled paper

incineration - burning; waste disposal technique, fifth priority in the waste management hierarchy

incinerator - facility designed for the controlled burning of waste; reduces waste volume by converting waste into gases and relatively small amounts of ash

inventory - a complete list of items and the quantity present in a particular place at a certain time

junk mail - unwanted advertisements or other material sent through direct mailings to consumers or businesses; can be controlled by restricting distribution of recipient's name and address

landfill - a large outdoor area for waste disposal; in sanitary landfills waste is layered with soil and compacted; lined landfills have a barrier to prevent leaking into the surrounding area (secure landfill)

leachate - the liquid formed when water passes through a landfill picking up a variety of suspended and dissolved materials from the waste; can be toxic and may be carried into the ground water if not contained

lightweighting - package design which requires less material in the packaging, e.g. thinner plastic bottle where strength is maintained by rounding the corners

lower-use - term used to describe products made from recycled materials which do not have as high quality as products made from new materials; paperboard is a lower use of fiber than office paper

macroorganisms - visible animals such as earthworms, sow bugs, mites, millipedes, and beetles that live in compost at the cool, end stage

mass burn incinerator - a type of incinerator in which waste is not separated before going into the burn chamber; white goods and obviously hazardous materials such as car batteries are usually removed, but little else is

mesophylic - compost bacteria which thrive in the middle range, warm-temperature stage of composting

methane- a colorless flammable gas; byproduct of anaerobic decomposition common in landfills which must be vented or burned to prevent gas buildup and potential explosion; can be used as fuel

monofill - a special secure landfill which is used only for a single type of waste, e.g. ashfill

MSDS (Material Safety Data Sheets) - information provided by manufacturers of hazardous substances which specify contents, and procedures for handling, storage, and disposal; also available from Flinn Scientific (see address in Resources)

MSW (municipal solid waste) - solid waste produced by residential, commercial, and institutional generators within a community, does not include industrial or agricultural waste

natural resources - materials derived from the earth which are used for energy or in the manufacture of goods

ni-cad (nickel-cadmium) - a type of rechargeable battery; can be recycled

open dump - traditional waste disposal method of open piles of garbage; now prohibited in Maine

overpackaged - term describing goods which have more packaging material than is necessary to simply wrap, contain, or protect the product; overpackaging is a source of waste that can be reduced

packaging - the materials used to wrap, contain, and protect products; may also advertise the product

paperboard - a type of thin cardboard used for products like cereal boxes; often made of recycled fiber

particulates - minute particles of ash carried in the hot gasses produced in incinerators; usually "scrubbed" before the gasses are released

plastic resin (polymer) - specific organic compounds which determine the characteristics of plastic; different plastic resins must be separated and recycled separately

post-consumer content - in a recycled product, the amount of material that has been previously used at the consumer level and returned for recycling and remanufacture

pre-consumer content - in a recycled product, the amount of material that has been recovered from the manufacturing process and recycled into a new product; recycled material that has not been used at the consumer level

psychrophilic - the first stage of composting in which simple bacteria thrive in cool temperatures producing carbon dioxide and heat

pulp - digested wood fibers that are then made into paper; new pulp is derived from wood, recycled pulp is derived directly from paper and is then remanufactured into recycled paper

raw materials - substances still in their natural state before processing or manufacturing; the starting materials for a manufacturing process; sometimes referred to as "virgin materials"

RDF (refuse-derived fuel) incinerators - facilities where non-combustible materials are separated and removed before going into the burn chamber; the recovered materials are reused or recycled

reactive - a category of hazardous material which tends to react spontaneously with air or water, explode when dropped, or release toxic gasses

recovered materials - those materials which are separated and collected for recycling, removed from the waste stream for sale, use, or reuse

recycle - a waste management strategy where materials from waste are recovered, reprocessed, and manufactured into new products; third priority in the waste management hierarchy

recycled - composed of materials which have been processed and used again

reduce - see source reduction; the first priority in the waste management hierarchy

refillable - term used to describe containers which can be used several times to hold the same product

returnable - can be returned for deposit and/or reuse

reuse - a waste management strategy which advocates finding alternative uses for items which are no longer needed for their original purpose; second priority in the waste management hierarchy

scrubbers - the mechanical and chemical cleaners of incinerator gasses; wet-dry scrubbers use limewater, baghouse filters settle particles out, electrostatic precipitators remove particles with an electric charge

slurry - mixture of water and paper fiber that comes from a hydrapulper as paper is recycled

small quantity generator - an individual, business, or organization that produces a measurable amount of hazardous waste but less than 1000 kilograms/ month; regulated in Maine by the Dept. of Environmental Protection Bureau of Hazardous Materials & Solid Waste Control

solid waste - any of a variety of solid materials and liquids that are considered unusable and must be discarded; includes household garbage, food waste, yard trash, white goods, ash, sludge, or other discarded material

source reduction - a waste management strategy which attempts to decrease the amount and toxicity of solid waste before a material enters the waste stream; reducing the amount of waste by design and engineering; first priority in the waste management hierarchy

sustainable future - the objective of many conservation efforts to minimize the use of resources in the maintenance of a productive lifestyle; an ideal vision of the future where there is no net loss of resources

thermophilic - high-temperature (105° - 158°F) compost bacteria, fungi, and molds that finish the compost process

tipping fee - the fee charged a waste hauler to deposit material at a transfer station, incinerator, or landfill

toxic - poisonous or harmful to humans and/or the environment

toxicity - a relative measure of how poisonous a substance is; an objective of source reduction waste is to reduce the toxicity of waste as well as the amount of waste

transfer station - a facility designed to store or hold solid waste for transport to a processing or disposal facility

trash - term used for the category of wastes that usually do not include food waste, but may include other organic materials such as yard trimmings

unrecoverable waste - waste which has no reusable or recyclable components and must be disposed of in landfill or incinerator

user fees - money charged to recipients of a particular service, e.g. fees charged by a trash hauler to collect trash curbside

vitrification - an experimental waste management process is which waste is exposed to extremely high temperatures and transformed into dense inert chunks of material

waste - any material that is not used and is discarded

waste audit - inventory of waste produced in a particular place over a certain period of time; the analysis from a waste audit can help identify targets for waste reduction and recycling efforts

waste exchange - a system which allows the waste from one activity to be used as a resource in another activity

waste management hierarchy - the priority order of managing waste developed by the EPA: 1) Reduce, 2) Reuse, 3) Recycle, 4) Compost, 5) Incinerate, 6) Landfill

waste stream - the total waste produced by a community or society, as it moves from origin to disposal; all of the waste generated in the process of production, utilization, and disposal of goods

waste-to-energy - the type of incinerator which generates electricity from the heat produced from burning waste

white goods - major household appliances such as refrigerators, washers, ranges that are typically but not always finished in white enamel

Alphabetical Index

PAGE		LEVELS
180	Appendix I: Tools for Action	
189	Appendix II: Instructional Resources	
192	Appendix III: Organizations and Agencies	
195	Appendix IV: Glossary	
56	Are Ten Better Than One?	● ■
163	Background Information: Composting	
174	Background Information: Household Hazardous Waste	
167	Background Information: Incineration	
171	Background Information: Landfilling	
148	Background Information: Overview	
157	Background Information: Recycling	
155	Background Information: Reuse	
152	Background Information: Source Reduction	
130	Battery Use Reduction and Rechargeable Battery Promotion	■ ◆
12	Birds of Zazurds	● ■ ◆
32	Birds of Zazurds: Birds of Zazurds Play	■
31	Birds of Zazurds: Our School the Gulligutt Tree	●
33	Birds of Zazurds: Zazurds II	◆
44	Bread and Kisses	■ ◆
124	"Buy Recycled" Campaign	● ■
135	Cafeteria Composting Project	● ■ ◆
107	Cafeteria Source Reduction Campaign	● ■ ◆
106	Classroom Source Reduction Campaign	● ■ ◆
132	Classroom Worm Bin Project	● ■
143	Comparison of Waste Disposal Methods: Landfill and Waste-To-Energy	■ ◆
36	Drop in the Bucket	● ■ ◆
48	Everyday Choices for a Sustainable Future	■ ◆
54	For Better or Worse	■ ◆
46	Getting to the Root of the Hazardous Waste Problem	■ ◆
128	Home Recycling Collection Center	■ ◆
90	Home Hazardous Waste Audit	■ ◆
88	Home Waste Audit	● ■ ◆
38	How Much Trash?	■ ◆
42	If Toys Could Talk	● ■ ◆
98	Landfilling Siting Investigation	◆
93	Local Waste Management Options	● ■ ◆
118	Magazine Reuse Campaign	● ■ ◆
40	Mounting Milk Cartons	●
58	Paper, Plastic, or Cloth?	■
116	Paper Reuse Campaign	● ■ ◆
115	Promoting Alternatives to Hazardous Products	■
109	School Source Reduction Publicity Campaign	● ■ ◆
122	School Recycling Program	● ■ ◆
104	Simple Classroom Action Projects	● ■ ◆
80	School Hazardous Waste Audit	■ ◆
76	School Waste Audit	● ■ ◆
83	Source Reduction/ Recycling Quiz	● ■ ◆
70	Test the Alternatives	● ■
96	Trash Sorting Relay Race	■ ◆
119	Trash to Art Festival	● ■
111	Unsolicited Mail: Who's in Charge Here?	● ■ ◆
117	Used Clothing Swap	● ■ ◆
120	Waste Paint Exchange Project	■ ◆
67	Where'd You Get That Can?	■